Negative affect, isolation and menstrual cycle as antecedents of eating in individuals with disordered eating. An Ecological Momentary Assessment study.

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Declaration of Originality

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Abstract

Disordered eating (DE) is a subclinical eating disorder that includes a wide range of unhealthy behaviours, spanning from occasional dieting and use of laxatives to chronic dieting that may eventually evolve into a clinical eating disorder. Several studies indicate that disordered eating is associated with distress and impairment, underscoring the need for intervention, as it is the most common indicator of the development of an eating disorder. However, little is known about factors that trigger and maintain disordered eating behaviours. For example, the literature supports the possible role of a dysfunctional attachment style, as well as proximal negative affect and immediate context, in precipitating disordered eating behaviours. Moreover, hormonal changes seem to be responsible for exacerbating disordered eating symptomatology in accordance with a particular phase of the menstrual cycle (e.g., prior to or during menstruation).

This dissertation examined the role of attachment style, negative affect, immediate context and menstrual cycle as possible antecedents of eating in disordered and normal eaters. Longitudinal changes one-hour prior to and after eating, and over a one-week period have been investigated. Moreover, the influence of menstrual cycle on eating intake in the disordered eating sample and general population has been studied.

The research utilised Ecological Momentary Assessment (EMA), a design that involved repeated assessments of current psychological and situational states in participants' natural environments. Forty-six male (Mean = 28.8 years old) and ninety female participants (Mean = 28.7 years old) with disordered eating (N = 55) and healthy controls (N = 81) were recruited from the community to make multiple daily ratings of affect, hunger levels, menstrual status (for the female sample), time and

location using random-, interval-, and event-contingent recordings. They had to record their food intake, mood and location over a one-week period, to investigate their eating pattern, and over a two-week period to study the impact of menstrual cycle on eating behaviours. Hierarchical regressions, Generalised Estimating Equations, repeated-measured Manova/Anova and Mixed Model analyses were used to examine between-day differences and within-day changes in psychological, situational variables relative to eating and menstrual status in disordered eating individuals and controls.

The results showed that the feeling of loneliness might predict disordered eating behaviours when moderated by an anxious attachment style [B (SE) = -1.62, p = .029)]. Levels of shame [Estimate (SE) = -.483 (.222), p = .030] and disgust [Estimate (SE) = -.428 (.177), p = .016] were higher at eating episodes, while guilt [Estimate (SE) =.639 (.189), p = .001] increased mostly after eating. Moreover, the results confirmed the importance of situational factors in precipitating disordered eating behaviours [e.g., being at home [OR (95%IC) = .847 (.753-.952), p =. 005], absence of others [OR (95%IC) = .883 (.786-.993), p = .037)]. This is the first study to demonstrate that there are within-person situational processes in disordered eating revealing that the absence of others might be a unique antecedent of eating pathology. In addition, loneliness, shame, disgust and guilt might play a unique role in triggering and maintaining disordered eating.

Menstrual cycle seemed to play an important role in influencing eating pattern in disordered eating individuals. Disordered eating females experienced cravings ($F = 41.25$, $p < .001$) and bloating ($F = 3.39$, $p < .001$) more frequently on menstrual days compared to non-menstrual days, while controls did not show much difference.

To conclude, findings suggest that the absence of others, high levels of

negative affect and the menstrual cycle might precipitate disordered eating behaviours in a subclinical disordered eating population.

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Literature review

Introduction

Disordered eating is a subclinical eating pathology that includes a wide range of unhealthy behaviours, spanning from occasional dieting and use of laxatives to chronic dieting that may eventually evolve into a clinical eating disorder (Pennesi & Wade, 2016; Liechty & Lee, 2013).

Symptoms of disordered eating include common behaviours of eating disorders, such as food restriction, binge eating, purging (via self-induced vomiting or excessive exercise, and use of diet pills and/or laxatives), but at a lesser frequency or lower level of severity (Keel, Forney, Brown, & Heatherton, 2013). In particular, disordered eating includes:

- Self-worth or self-esteem based highly or even exclusively on body shape and weight (Braun, Park, & Gorin, 2016);
- A disturbance in the way one experiences their body (i.e., a person who falls in a healthy weight range, but continues to feel that they are overweight; Rodgers & Chabrol, 2009);
- Excessive or rigid exercise routine (Goodwin, Haycraft, & Meyer, 2016);
- Obsessive calorie counting (Froreich, Vartanian, Grisham, & Touyz, 2016);
- Anxiety about certain foods or food groups (Norris et al., 2014);
- A rigid approach to eating, such as only eating certain foods, inflexible meal times, refusal to eat in restaurants or outside of one's own home (Eisenberg, Berge, & Neumark-Sztainer, 2013).

Because eating disorders are diagnosed using strict clinical criteria, the prevalence of unhealthy eating behaviours, such as disordered eating, is believed to be much higher than it appears (Torstveit, Aagedal-Mortensen, & Stea, 2015; APA, 2013). For example, only 2-4% of the population meet the criteria for a full syndrome of eating disorder, even though many more are suffering from partial and atypical syndromes (Aspen et al., 2014).

Estimates suggest almost one-quarter of young women have experienced disordered eating behaviours (including binge eating, purging, and/or fasting) in the previous 12-month period, supporting the idea that a moderate degree of eating pathology is now normative among young women (Wade, Wilksch, & Lee, 2012).

In addition, over the last decade there has been increasing awareness of the existence of eating pathology among men (Chapman & Woodman, 2016; Dakanalis et al., 2015; Dakanalis, Timko, Clerici, Zanetti, & Riva, 2014), showing comparable dietary restraint, driven exercise (i.e., exercising in compulsive manner as a means of controlling weight and/or shape) and binge eating rates, as well as levels of clinical impairment, to women (Mitchison & Mond, 2015).

Even though the symptoms of disordered eating might not be as extreme as those of a diagnosable eating disorder, it is problematic and needs to be taken seriously. Individuals with disordered eating may be at risk of developing a full-blown eating disorder and are more likely to have a history of depression and/or anxiety, or be at risk for anxiety and depression at some point in their life (Ward & Hay, 2015).

Researchers have suggested that eating pathology should be viewed on a continuum that ranges from lack of concern with weight/shape and normal eating patterns to “normative discontent” with weight/shape and moderately

disordered/restrained eating to anorexia nervosa, bulimia nervosa, and other diagnosable eating disorders (Melin, Torstveit, Burke, Marks, & Sundgot-Borgen, 2014).

Most eating disorders typically begin as a voluntary restriction of food intake, where the restrictive eating behaviour progresses to chronic dieting and frequent weight fluctuation with increasingly pathological eating and weight-control behaviours with/or without excessive exercise (Aspen et al., 2014). The continuum therefore starts with appropriate eating and exercise behaviours, including periodic dieting or occasional use of more extreme weight loss methods such as short-term restrictive dieting. At the end of the continuum are the overt clinical eating disorders where the sufferers struggle with abnormal eating behaviours, distorted body image, weight fluctuation and extreme dieting with regular use of pathological compensatory strategies such as fasting, dehydration, vomiting, laxatives and weight loss drugs (Sundgot-Borgen & Torstveit, 2010).

To sum up, eating pathology (which includes full eating disorders and subclinical eating disorders, such as disordered eating) shares the characteristic that self-respect is linked to weight and physical appearance, and the perception of body image is disturbed and deeply unsatisfactory. The body is perceived in a negative way, causing a decrease in self-esteem. In addition, the simultaneous presence of biological, cultural and psychological aspects makes this psychopathology very complex (Fairburn & Cooper, 2007).

Research about the aetiology of disordered eating and eating disorders is continuing to grow all over the world, since the phenomenon is becoming more common (Mond & Arrighi, 2012). However, there is still strong uncertainty about the aetiology and additional research is needed (Badawy, Aal, & Abulatta, 2009).

Diagnostic criteria

The *Diagnostic and Statistical Manual of Mental Disorders* defines eating disorders as "severe disturbances in eating behaviours including, but not limited to, excessive fasting, repeated episodes of binge eating, or inappropriate compensatory behaviours". Disordered eating, obesity cases and feeding issues in infancy are excluded both in DSM IV-R and DSM-5 (APA, 2013).

The most common diagnostic categories of eating disorders are: Anorexia Nervosa, Bulimia Nervosa, Binge Eating Disorder and Other Specified Feeding or Eating Disorder (OSFED), a category for those who do not meet the required criteria for a diagnosis in anorexia, bulimia nervosa or binge eating disorder.

A common hypothesis is that all the different types of eating disorders are a different manifestation of the same condition because the core symptomology typically includes: being female (Fragkos & Frangos, 2013); body dissatisfaction (Ferguson, Munoz, Garza, & Galindo, 2013); preoccupation with food, weight, and shape (Gagne et al., 2012); and certain ego deficits (Obeid, Buchholz, Boerner, Henderson, & Norris, 2013).

Anorexia nervosa sufferers typically tend to restrict their energy intake, leading to a significantly lower body weight in the context of age, sex, developmental trajectory, and physical health. They show an intense fear of gaining weight or becoming fat, even though underweight; actually, they display a disturbance in the way in which their body weight or shape is experienced, an undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight (APA, 2013).

According to DSM-5, anorexia nervosa is characterised by a distorted body image and excessive dieting that leads to severe weight loss with a pathological fear

of becoming fat. The interesting aspect is that the fear of gaining weight is not eased by weight loss (Hebebrand & Bulik, 2011). The distorted body image involves disturbances in the perception, experience or over-evaluation of weight or shape representing the specific psychopathology of eating disorders. Individuals with anorexia commonly judge the self-value and themselves based on their weight and the capacity to control their calorie intake (Gual et al., 2002), making weight loss and control over eating an important component of the illness.

Individuals with anorexia seem to have the ability to severely restrict food with an extreme self-discipline and control. This latter aspect enables them to increase their self-worth (Myslobodsky, 2005). The lifetime risk for anorexia nervosa among women is estimated to be 0.3 to 1% (with a greater frequency of subclinical anorexia nervosa) and among men about a 10th of that rate (Bewell-Weiss & Carter, 2010).

Compared to anorexia nervosa, bulimia nervosa is categorised by (APA, 2013): recurrent episodes of binge eating, characterised by of the following: eating in a discrete amount of time (within a 2 hour period) large amounts of food; sense of lack of control over eating during an episode; and recurrent inappropriate compensatory behaviour in order to prevent weight gain (purging). The binge eating and compensatory behaviours both occur, on average, at least once a week for three months and self-evaluation is unduly influenced by body shape and weight. Bulimia nervosa is the most prevalent of the two disorders, with diagnosed patients outnumbering anorexia nervosa patients 2 to 1 (Gowers & Shore, 2001). Young women suffering from bulimia nervosa are harder to detect compared to the anorexic counterparts, because they usually maintain normal body weight and their purging episodes happen in private settings.

The formal criteria of the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-5), require that both binge eating and the compensatory behaviour occur at least once a week; nonetheless, there is wide variation in behaviour, with patients that purge from 5 to 10 times or more per day (Grilo et al., 2009). The level of severity of bulimia is based on the frequency of inappropriate compensatory behaviours (Hartmann, Zeeck, & Van Der Kooij, 2009). The prevalence of bulimia nervosa may be increased among patients with type 1 diabetes; some patients deliberately avoid taking insulin in order to induce weight loss (Yan, 2007).

The category "Other Specified Feeding or Eating Disorder (OSFED)" is characterised by disturbances in eating behaviours that do not necessarily fall into the specific category of anorexia, bulimia, or binge eating disorder. Other Specified Feeding or Eating Disorder (OSFED) is a category for eating disorders that, according to the DSM-5, incudes: atypical anorexia nervosa (when all of the criteria for anorexia nervosa are met, except significant weight loss and the individual's weight is within or above the normal range); atypical bulimia nervosa (when all of the criteria for bulimia nervosa are met, except that the binge eating and inappropriate compensatory behaviours occur, on average, less than once a week and/or for less than 3 months); atypical binge-eating (when all of the criteria for binge-eating disorder are met, except the binge eating occurs, on average, less than once a week and/or for less than 3 months); purging disorder (when a recurrent purging behaviour is present in order to influence weight or shape in the absence of binge eating; Stoving et al., 2012); night eating syndrome (when recurrent binge-eating episodes take place during the night, as manifested by eating after awakening from sleep or by excessive food consumption after the evening meal; Palmese et al., 2013).

Binge Eating Disorder (BED) is characterised by frequently eating excessive amounts of food, often when not hungry, and with no inappropriate weight compensatory behaviours as seen in bulimia nervosa (APA, 2013). The binge eating occurs, on average, at least once a week for three months and it usually occurs in secret, followed by feelings of guilt and shame. A binge may consist in an intake of over 50,000 calories from food at one time (20 to 25 times the normal daily energy intake the average person needs in order to function). Similar to individuals with anorexia and bulimia, individuals with binge eating feel a loss of control over food intake, followed by feelings of guilt, shame and disgust. These feelings may lead to depression and possible long-term risks associated with obesity. Even though individuals with binge eating can be of normal weight, about 30% of this population have problems with obesity (De Lenclave, Florequin, & Bailly, 2001).

Table 1 summarises the principal characteristics of the recognised eating disorder subtypes:

Table 1. Comparison between eating disorders

Symptom	**AN restricting**	**AN binge/purge**	**BN**	**BED**	**OSFED**
Body weight	< 15% of normal weight	< 15% of normal weight	Normal, underweight or overweight	Normal, underweight or overweight (30% is overweight)	Normal, underweight or overweight
Body Image	Severely Disturbed	Severely Disturbed	Over-concerned with weight	Disgusted with weight	Over-concerned with weight
Binge	NO	YES	YES	YES	YES
Inappropriate Compensatory Behaviours	NO	YES	BN purging type: YES BN non purging type: NO	NO	YES
Lack of control	NO	YES	YES	YES	YES
Hormonal imbalance	Amenorrhea, low testosterone	High testosterone, possible Polycystic Ovarian Syndrome (PCOS)	High testosterone, possible PCOS	High testosterone, possible PCOS	Amenorrhea, low testosterone, High testosterone, possible PCOS

Disordered Eating is a subclinical eating disorder that can include behaviours, which reflect many, but not all, of the symptoms of clinical eating disorders (Liechty & Lee, 2013). Disordered eating behaviours, in particular dieting, are the most common indicators of the development of an eating disorder. Even if it is not a clinical eating disorder, it has a destructive impact upon a person's life and has been linked to a reduced ability to cope with stressful situations, along with an increased incidence of suicidal thoughts and behaviours (Eisenberg et al., 2013).

Examples of disordered eating include: fasting or chronically restrained eating, skipping meals, self-induced vomiting, restrictive dieting, unbalanced eating (e.g. restricting a major food group such as 'fatty' foods or carbohydrates), laxative,

diuretic and enema misuse, steroid and creatine use (supplements designed to enhance athletic performance and alter physical appearance), and inappropriate use of diet pills (Loth, MacLehose, Bucchianeri, Crow, & Neumark-Sztainer, 2014).

Feelings of guilt and failure are common in people who engage in disordered eating. These feelings can arise as a result of binge eating, 'breaking' a diet or weight gain. People with disordered eating behaviours may isolate themselves for fear of socialising in situations where people will be eating. This can contribute to low self-esteem and significant emotional impairment (Lampard, Byrne, & McLean, 2011). Principal characteristics of disordered eating are shown in Figure 1.

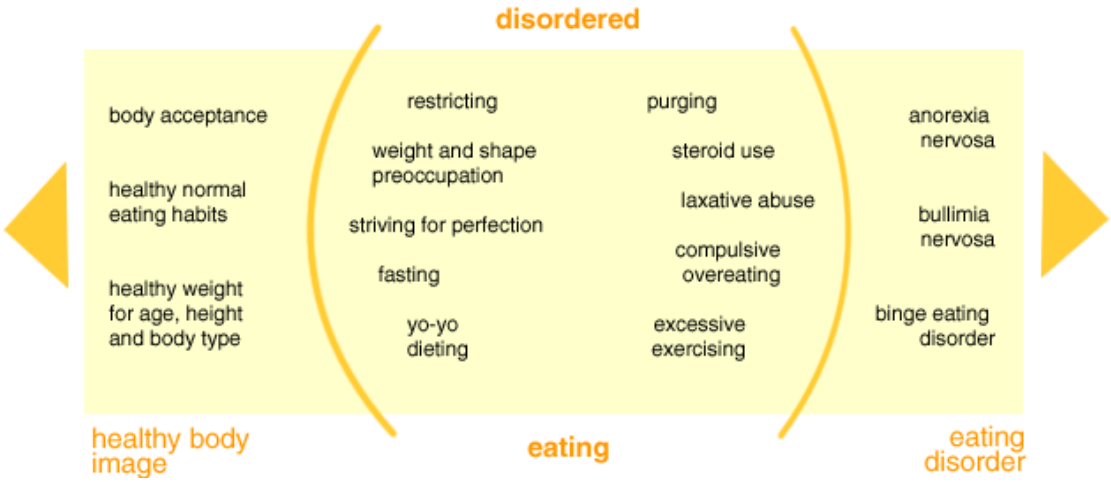

Figure 1. Characteristics of disordered eating ("Eating Disorder or Disordered Eating?," 2013)

To sum up, every practice that includes disordered eating behaviours disrupts the normal bodily functions and it negatively impacts a person's emotional, social and physical wellbeing. Even if a disordered eating pattern may not fall under a specified category of eating disorder, it does not mean it cannot have a widespread and destructive impact on a person's life (Claus, Braet, & Decaluwe, 2006; Bulik, Sullivan, Carter, & Joyce, 1997).

Risk factors and theories of eating pathology

Biopsychosocial factors of eating pathology

Despite the fact that no certain cause has been found, many factors may contribute to the development of eating pathology, such as personalities, genes, environment and biochemistry (Goldschmidt, Wall, Loth, & Neumark-Sztainer, 2015; Jackson & Chen, 2014).

In accordance with the biopsychosocial model (Smolak & Levine, 2015), the development of eating pathology is likely to be multifactorial in nature that includes biological, psychological, and sociocultural factors (Ball & Lee, 2002). For example, a number of studies have found that biological factors (i.e., hormonal imbalance), psychological factors (i.e., low self-esteem and body image), contextual factors (i.e., eating with or without other people) and sociocultural factors (i.e., social pressures to be thin and weight-related teasing) increase the risk of eating pathology (Striegel-Moore & Bulik, 2007; Kugu et al., 2006).

However, these risk factors are often studied individually and little is known about how they might interact. The dissertation proposes an interaction of four different factors in accordance with the biopsychosocial model, which are conjunctly investigated. The factors proposed are: social factors (attachment style and social comparison), psychological factors (emotional dysregulation and negative affect), situational factors (immediate context and situations of eating) and biological factors (ovarian hormones and menstrual cycle).

Social Factors

Attachment style

The relationship between parents and their children was named by Bowlby attachment (1970) who defined it as "a behavioural system for regulating safety and survival by maintaining proximity to attachment figures, usually parental caregivers, and seeking out these individuals for protection and support in times of distress".

Attachment is a specific relationship defined by the child's use of the parents or attachment figures as a source of security. The affective experience of seeking out attachment figures and having one's needs met is synthesised into an internal working model, which represents the relationship between self, attachment figure and the world. The internal representation that is formed will be used to shape and give meaning to all the future relationships (Bowlby, 1978).

Since the attachment patterns established in childhood have an important impact on later relationships, disruptions in normal attachment processes create intense separation distress and vulnerability, and might contribute to the development of eating pathology (Ty & Francis, 2013). Early attachment style formed in childhood will be responsible for shaping the dynamics of future interpersonal relationships between humans (Tasca, Ritchie, & Balfour, 2011).

Based on Bowlby's (1970) theory, four types of attachment patterns have been identified in observations of 12-month old infants and their mothers: secure, insecure-avoidant, insecure-resistant and insecure-ambivalent (Sorrentino et al., 2002). The secure type is characterised by the ability to tolerate separation from the parent with appropriate levels of emotional distress upon separation, comfort at the reunion and limited difficulty leaving the mother's side to play.

Lack of distress of separation and avoidance of the parent at the reunion with no display of emotion characterised the insecure-avoidant type. These children appeared angry with mothers and exhibited anxiety about her proximity. The insecure-ambivalent type is preoccupied with the mother, alternating between engaging and resisting interaction; insecure-ambivalent children appeared to be passive or actively angry and reacted to reunion with the mother with emotional distress that did not abate (De Zwaan, 1997).

From this earlier research with infants and mothers, a typology of adult attachment was created. Attachment categories are assigned according to common elements in self-description and attachment experiences and comprise two groups; secure and insecure (De Zwaan, 1997).

Adults with a secure attachment style tend to have trusting, long-term relationships. They are individuals with high self-esteem; they display the capacity to create intimate relationships, social support, and the ability to share feelings with other people.

Insecure attachment style includes different subtypes: anxious and avoidant. Anxious attachment presents feelings of ambivalence about relationships: on one side, anxious adults have the desire to be close to others but at the same time they strongly fear rejection. This leads to frequent breakups, often because the relationship feels cold and distant (Mikulincer, Shaver, Sapir-Lavid, & Avihou-Kanza, 2009).

People with an avoidant attachment style desire a high level of independence and they tend to avoid relationships. They view themselves as self-sufficient and invulnerable. They often deny the need for intimate relationships. People with an avoidant attachment style tend to suppress and hide their feelings, distancing themselves from any possible source of rejection (Bogaerts, Kunst, & Winkel, 2009).

They are uncomfortable getting close to others; they have mixed feelings about intimate relationships. On the one hand, they desire them; on the other hand, they tend to be uncomfortable with emotional closeness. These mixed feelings are combined with, sometimes unconsciously, negative views about themselves and their partners. They commonly view themselves as unworthy of responsiveness from their partners, and they don't trust the intentions of their partners. They seek less intimacy from partners and frequently suppress and deny their feelings (Li & Fung, 2013). Principal characteristics of the types of attachment style are shown in Table 2.

Table 2. Types of attachment style

Secure	Anxious	Avoidant
Positive view of self	Negative view of self	Positive view of self
Positive view of others	Positive view of others	Negative view of others
Interdependent	Dependent	Independent/ self-reliant
Comfortable with emotional intimacy	Fear of losing relationship	Difficulties to get close to others
Comfortable with closeness	Emotional highs and lows	Put up walls
Healthy relationship bonds	Can be aggressive	Leaves or avoids during conflicts
Secure and trusting	Clingy on separation	Do not need others
	Fear of abandonment	

Attachment style is a relatively stable developmental trait (Eggert, Levendosky, & Klump, 2007). For example, anxious attachment is theorised to develop when caregivers are inconsistent or unpredictable in responding to the child's needs (Tasca et al., 2009). It has been suggested that an anxious attachment reflects a negative working model of the self in which individuals tend to be sensitive to rejection or threats to security, and usually exhibit low self-esteem due to a sense of

unworthiness of care, a need for approval from others, and persistent fears of abandonment in relationships with important others (Cheng & Mallinckrodt, 2009).

Avoidant attachment appears to develop when the child perceives their caregiver to be rejecting or unavailable and, as a result, defensively disengages from the attachment relationship (Tasca et al., 2009). Avoidant attachment is seen to reflect a negative working model of others, resulting in a fear of intimacy in close relationships due to a sense of distrust.

Attachment style in eating pathology

Individuals, suffering from disordered eating and/or eating disorders, share some characteristics with those who have an insecure attachment style (Ty & Francis, 2013), such as an eagerness to please and a tendency to draw self-esteem from approval from others (Tasca & Balfour, 2014).

In order to differentiate avoidant and anxious attachment in relation to eating pathology, anxious attachment has been associated with a need for external approval; it has been suggested that anxious individuals may be more susceptible to sociocultural ideals of thinness and beauty and, as a result, may exert greater control over their weight and body shape (Van Durme, Braet, & Goossens, 2015).

On the other hand, avoidant attachment has been associated with distancing behaviours, and eating pathology may be a strategy to prevent the individual from requiring comfort (represented by food) or to provide a substitute for the attachment relationship (Eggert et al., 2007).

The consistent support for an insecure attachment style in eating disorders and disordered eating has underscored the importance of understanding how interpersonal

difficulties established in early relationships influence eating pathology later in life (Tasca, Ritchie, & Balfour, 2011).

Theoretically, attachment difficulties in adolescence and adult life result from failure to successfully negotiate separation-individuation from the attachment figure to achieve autonomy or independence. More recent theorists have proposed that autonomy is only one dimension of separation: without interpersonal relatedness or connectedness, separation is detachment or alienation. They suggest that the developmental task of separation-individuation requires the development of autonomy within the context of connecting to parental figures (Kovacs, Mahon, & Palmer, 2002).

Women seem to find more difficult to reconcile their desire for a sense of connectedness with pressures to become more independent, since women's sense of self is grounded in the capacity to maintain psychological connectedness in relationships with others (Liechty & Lee, 2013). It has been suggested that women with an insecure attachment style may develop an eating pathology due to a desire for approval from others; they tend to devalue themselves and have a heightened fear of rejection, which can lead to social comparison tendencies, body dissatisfaction and a preoccupation with weight loss (Bamford & Halliwell, 2009).

However, an insecure attachment is not a unique feature of eating pathology, but it an aspect found also in mood and anxiety disorders, schizophrenia, borderline personality disorder and antisocial personality disorder (Dozier, Stovall-McClough & Chase, 2008)

This might indicate that attachment insecurity may be only one of several factors that contribute to the expression of eating disorders symptoms (Tasca & al., 2009) and other aspects might be involved as well. However, no studies have

examined the role of attachment style in accordance with the biopsychosocial model including in the analysis other factors that might contribute to eating pathology (e.g., psychological or biological aspects), and further research is needed.

Social comparison in eating pathology

Social comparison theory states that humans engage in social comparison with others to understand how and where they fit into the world when objective standards are not available (Fitzsimmons-Craft, Harney, Brownstone, Higgins, & Bardone-Cone, 2012). Comparing oneself to others, both intentionally and unintentionally, is a pervasive aspect of social interactions and has been described as a "core element of human conduct and experience" (Suls, Martin, & Wheeler, 2002).

Research has indicated that women frequently make appearance-related social comparisons (Leahey, Crowther, & Mickelson, 2007), and one negative consequence that may result when the comparison is unfavourable is body dissatisfaction (Myers & Crowther, 2009; Trampe, Stapel, & Siero, 2007). Indeed, comparisons made by women on their appearance are generally upward (i.e., the individual compares themselves to someone they consider more attractive or better in some area; Morrison, Kalin, & Morrison, 2004).

However, not only upward comparison, but also general social comparison tendencies are often associated with body dissatisfaction as well (Morrison et al., 2003). Studies found that the general tendency to compare one's performance with others was significantly correlated with body dissatisfaction in a sample of college women (Gilbert & Meyer, 2003, Morrison et al., 2003).

In addition, research found that the extent to which individuals engage in everyday social comparison is likely to differentiate women who exhibit eating

disorders symptoms from those who do not. Secondly, when women make comparisons of their bodies to other women's bodies, more negative, or self-defeating conclusions are likely to predict the presence of eating disorders symptoms (Corning, Krumm & Smitham, 2006).

Social comparison seems to be correlated with eating pathology (Bamford & Halliwell, 2009), yet a critical question is by what mechanism(s) social comparison contributes to eating disorder is still to be answered (Tiggemann & Miller, 2010).

A possible hypothesis takes into account that the process of social comparison in eating pathology is based on polar opposites (e.g., good/bad; stupid/intelligent; right/wrong) that shape personal constructs (Castiglioni, Faccio, Veronese, & Bell, 2013). The dominant polarity dimension in eating pathology can be identified with the construct "winning/losing". This polarity is purely relational: you are a winner if you are in control (for example over eating), while you are a loser if you are passive and dominated (for example by food).

Specifically, individuals with bulimia and binge eating would often occupy the "losing" polarity due to their lack of control over their binge eating pattern, while individuals with anorexia would place themselves close to the "winning" polarity since they are able to maintain a strict control over their eating pattern. Since the feeling of "winning" or "losing" is considered a fundamental condition in defining their identity and they depend solely on interpersonal comparison, the sufferers show a strong sensitivity to the judgment of others and to parameters of social success (Ugazio & Fellin, 2009). Thus, an eating pathology might arise when a dyadic polarity (such as "winning" or "losing") due to social comparison becomes salient and pervasive among interactions (Faccio, Belloni, & Castelnuovo, 2012).

In order to test the hypothesis that social comparison in eating pathology is based on the winning/losing polarity, studies used the Repertory Grid Test (Fransella, Bell & Bannister, 2004). Unfortunately, like all retrospective studies, they did not provide sufficiently clear evidence to support the model because there was not a consistent pattern (Castiglioni et al., 2012; Faccio & Belloni, 2013).

The real problem, however, is that the design of most studies was such that they could not really test the polarity because they were not able to measure the mood in a variety of situations and they are limited to recalled information (which are influenced by reconstructive processes that reduce its accuracy; Moskowitz & Young, 2006). For this reason, additional research utilising ecological measures might be fruitful to undertake.

Psychological factors

Emotional dysregulation and negative affect

Emotional dysregulation has been conceptualised as impairment in one's awareness, understanding and acceptance of emotions. Emotionally dysregulated individuals show an inability to behave adaptively while experiencing negative emotions, and an inability to use appropriate strategies to modulate emotional responses in line with one's goals and circumstances (Lavender et al., 2015).

It has been hypothesised that eating disordered individuals have deficits in emotion processing related to an impaired ability to identify their emotions and have a lower level of emotional awareness in general. This difficulty is expressed in the communication style of people with disordered eating and/or eating disorders, which is usually low in self-disclosure and less expressive of emotions (Cagar-Nazai et al., 2014; Cunha, Relvas, & Soares, 2009).

It seems that disordered eating and eating disorder individuals have more difficulties in recognising emotions and they are less able to employ self-soothing strategies when distressed (Goossens, Braet, Van Vlierberghe, & Mels, 2009; Zeeck, Stelzer, Linster, Joos, & Hartmann, 2011).

Disordered eating and eating disorder individuals show limited flexibility in adapting their emotional regulation strategies to the situation or specific context (Gratz & Roemer, 2008). For example, among adolescent girls, high levels of negative affect are mostly linked to maladaptive coping strategies and to disordered eating symptomatology (Lavender & Anderson, 2010). Therefore, eating disorder sufferers seem unable to properly regulate negative affect (Bydlowski et al., 2005), which play an important role in eating pathology (Engel et al., 2013).

Literature (Haedt-Matt & Keel, 2011; Ranzenhofer et al., 2014) confirms that the highest rate of binge eating and purging episodes occurs on days characterised by high levels of negative affect (Crosby et al., 2009). In particular, negative affect seems to predict a loss of control over eating (Svaldi, Griepenstroh, Tuschen-Caffier, & Ehring, 2012).

Eating disorders and disordered eating have also been linked to a number of different negative affective states. For example, disordered eating behaviours are linked to elevated levels of guilt, envy, shame and anxiety (Muris, 2015). This aspect can be explained when we take into consideration that individuals high in the trait of self-criticism, such as eating disorder and disordered eating sufferers, are thought to be especially susceptible to feelings of shame, envy (Arnocky et al., 2016), guilt and hostility (Kelly & Carter, 2013).

Self-criticism is a personality trait characterised by an excessive focus on achievement, harsh self-evaluation, and strong fears of failure and rejection (Duarte et

al., 2014), and has been linked to early experiences with critical, controlling, and/or insufficiently warm carers (Campos, Besser, & Blatt, 2013).

Eating disorder sufferers frequently find themselves in a vicious cycle where they are critical of themselves and their bodies, thereby triggering and intensifying feelings of shame and envy, leading to behaviours focused on altering their weight and shape (Manjrekar, Schoenleber, & Mu, 2013).

In the case of anorexia nervosa, restrictive eating and excessive exercise might temporarily reduce shame by increasing positive feelings of being able to control the amount of food eaten. In bulimia nervosa, bingeing and purging might help individuals escape feelings of shame and guilt temporarily, but the perceived abnormalities of those behaviours ultimately perpetuate self-critical thoughts and a sense of being flawed (Goss & Allan, 2009).

Moreover, women with an eating pathology have been found to have higher levels of anger and to suppress their anger more than healthy controls. This was especially true for women who binged and purged and the different purging measures (vomiting, exercise, or laxative abuse) might reflect different emotional functions (Waller et al., 2003). For example, women who binged and vomited reported higher levels of "trait" anger (the disposition to experience angry feelings), while excessive exercisers reported higher levels of "state" anger (the intensity of angry feelings), and laxative abuse was associated with anger suppression (Saldana, Quiles, Martin, & del Pilar Salorio, 2014).

Interestingly, the increase in food intake in response to negative emotions has been found among normal eaters as well; various studies have pointed to a connection between an increase in the amount of food eaten and emotions in normal eaters (Fassino, Leombruni, Piero, Abbate-Daga, & Rovera, 2003). A study shows that

women scoring high on an emotional eating scale (meaning they were more likely to respond to negative emotional stimuli by eating) consumed more ice cream under controlled conditions than women who scored low on emotional eating (Van Strien, 2000). This aspect suggests that the link between negative affect and eating is not unique to those with clinically significant levels of eating disorder symptomatology.

Unfortunately, research on the role of negative affect in eating pathology is limited by the fact that negative affect is a broad umbrella term encompassing multiple facets and many types of emotional experiences (e.g., depression, anxiety), which might be difficult to investigate.

For example, previous studies have compared facets of negative affect at different time points in relation to eating disorders episodes in women with a recognised eating disorder. The most common facets of negative affect examined were depression, anxiety, anger, and guilt (Berg & Crosby, 2015; Heron, Scott, Sliwinski & Joshua M. Smyth, 2014; Goldschmidt &Wonderlich, 2014; Berg et al., 2013; De Young et al, 2013; Scott et al., 2013). The comparisons were immediately prior to versus immediately after eating disorder behaviour and immediately after versus some point in time after eating disorder behaviour (which varied between studies).

The results of the studies are relatively inconsistent, showing both an increase in negative affect prior to (Berg & Crosby, 2015; Berg et al., 2013), after eating (Engel et al., 2013), while others show a decrease in negative affect after eating (Berg & Crosby, 2015; Berg et at., 2013; De Young et al., 2013). Additionally these studies showed a different trend for the general negative affect and different facets under investigation. For example, guilt was usually higher than other facets at the time of binge-only and binge/purge events. Furthermore, post hoc analyses demonstrate that

guilt increased prior to and decreased following the eating episode (Berg & Crosby, 2015).

To sum up, previous literature lacks of pinpointing with precision, which facet assumes the greatest role for precipitating an eating disorder episode; it is still very confusing and it has not fully investigated especially in subclinical eating disorders. Moreover, determining which eating disordered behaviour is related to negative affect in general or to a particular facet of negative affect (e.g., depression) is particularly important to treatment development, because it has the potential to determine the content and focus of new interventions.

Situational context in eating pathology

Research showed that the specific context or setting might have an influence on eating behaviours (De Castro, King, Duarte-Gardea, Gonzalez-Ayala, & Kooshian, 2012). Contextual situations refer to features of the environment that influence human behaviour. Studies illustrate that changes in situations result in surprisingly robust changes in eating behaviour (Wansink, 2004; Zenk et al., 2014). Eating in restaurants/cafés, eating with others and alcohol consumption have all been shown to increase food consumption (De Castro et al., 2012; Martin, 2015). These situations share the common factor of being in novel situations, which might be responsible for decreasing control over food intake and they could trigger a change in eating patterns (O'Connor, 2015). On the other hand, physical activity has also been suggested to increase palatability of food and change food intake, especially in women (Martins, Morgan, & Truby, 2008).

Other studies suggest that time might also influence eating patterns. For instance, there is evidence showing that people change their eating patterns on

weekends compared to weekdays (Haines, 2003). Moreover, people seem to eat more in the evening. For example, people are more likely to break their diet later in the day because they are fatigued and have fewer self-control resources available (Allison, Goel, & Ahima, 2014).

Moreover, the presence of others has been shown to affect what and how much people order or serve themselves and what and how much they consume and thus it exerts a powerful effect on their behaviour. For example, research on the social facilitation of eating shows that people eating with others generally eat more food than those eating alone (De Castro & De Castro, 1989). Additionally, it has been shown that the more people present, the more everyone eats (Hetherington, Anderson, Norton, & Newson, 2006), possibly because a meal with many eaters tends to have a longer duration (Pliner, Bell, Hirsch & Kinchla, 2006).

Results show that people tend to eat more or less depending on the amounts eaten by their eating companions (Robinson et al, 2013). For example, women generally adapt their food intake to that of others. It has been argued that women's motivations related to eating are complicated by the "thin ideal". This refers to a cultural value placed on thinness, which is equated with success and attractiveness, and applies predominantly to women (Thompson & Stice, 2001).

Consistent with the notion that women more than men are under pressure to conform to this thin ideal, it has been argued that impression management related to food and eating may be more important for women than for men (Vartanian, Herman, & Polivy, 2007; Herman & Polivy, 2004). Therefore, we would expect that women would attend more closely to normative information regarding appropriate food intake and choice. This will lead women to adjust their eating more readily to that of others.

Other studies show, on the other hand, that eating behaviours might also be affected by cohabitation status and absence of others. For example, people living alone are less likely to have an opportunity to eat with others and this might have an impact on the amount of food eaten.

Tani (2015) shows that eating alone was associated with unhealthy dietary behaviours in men and women and it was associated with obesity. Moreover, among men, the effects of eating alone were stronger if they lived alone, while among women, the effects of eating alone were stronger if they lived with others. This might indicate that the combined effects of eating alone and living alone on meal skipping and obesity were more prominent in men than women. Conversely, women who ate alone were more likely to skip meals and be obese when they lived with others (Tani et al, 2015).

Taken together, although the association between disordered eating and poor dietary behaviours has been found to be prominent (Tani et al., 2015), the empirical data do not provide a clear picture of possible differences between eating intake based on sex, time, cohabitation status and presence of others (Exline, Zell, Bratslavsky, Hamilton, & Swenson, 2012; Herman & Polivy, 2015).

Moreover, other aspects seem to assume relevance in eating pathology. For example, literature shows that stressful events seem to temporally precede the occurrence of eating disorder behaviours (especially for binge eating and binge/purging episodes). Interpersonal stressors, general daily hassles, and stress appraisal predicted increases in binge eating and purging behaviours when tested simultaneously against one another (Goldschmidt & Wonderlich, 2014).

These data suggest when women experienced a greater number of stressful events they are more likely to experience subsequent increases in negative affect

along with eating pathology behaviours (Woods, Racine & Klump, 2010). Unfortunately these results apply just to women with bulimia nervosa, while other eating disorders or subclinical eating disorders, as well as general population, have not been investigated (Smyth & Wonderlich, 2009; Smyth & Wonderlich, 2007).

Additional research including sample of males and females with different eating disorder diagnoses, disordered eating and general population and a more systematic look at situational and contextual differences in eating behaviour might have a strong relevance for understanding the process by which eating pathology behaviours occur (Liao, Intille, & Dunton, 2015).

Biological factors

Eating pathology in females

Females are the most affected population group compared to males, with a female-male ratio of anorexia and bulimia nervosa of 10:1 (DSM-5, 2013). Different triggers may cause this preponderance of disordered eating and eating disorder behaviours in women. For example, sociocultural values typical of western culture , such as, thin ideal and fat-phobia, along with low self-esteem, dysfunctional coping skills and attachment styles might make women more vulnerable to disordered eating behaviours, especially during transitions or periods of stress: such as adolescence, young adulthood, divorce, death, menopause (Stanford & Lemberg, 2012).

Eating pathology in women significantly affects menstrual functions; in fact, menstrual abnormalities are often an early feature of these disorders in females (Morgan, 1999). Eating disorders and disordered eating in females appear to be

related to two hormonal phenomena: the specific phase of the menstrual cycle (Vyver, Steinegger, & Katzman, 2008) and hormonal secretion (Lofrano-Prado et al., 2010).

In particular, high levels of cortisol have been connected with the perception of stress, making both stress and cortisol strong elements in the onset and maintenance of eating pathology. In fact, a period of increased stress may result in both increased cortisol secretion and increased disordered eating pattern. Alternatively, an exacerbation of the disorder may increase psychological and physiological stress, which, in turn, may trigger a rise in cortisol secretion. For example, after the consumption of a large amount of food, subjects with bulimia demonstrated a persistent elevation of plasma cortisol levels compared to controls (Lester, Keel, & Lipson, 2003). People with anorexia display a hypercortisolemia as well (Putignano et al., 2001), along with deficiency in androgens, often in association with depression and/or anxiety (Miller et al., 2007).

Individuals with bulimia nervosa and binge eating display a different pattern: studies have found elevated levels of testosterone and adrenal androgens in bulimic women compared to control women (Shiffman, Farrel, & Yee, 1994). Case studies have acknowledged a decrease in binging and purging behaviours following treatment with a testosterone-receptor antagonist, thereby suggesting that androgens may contribute to a binging eating pattern (Sundblad, Landen, Eriksson, Bergman, & Eriksson, 2005).

Menstrual cycle and eating pathology

Variations in a number of human behaviours during the menstrual cycle are well known. The luteal phase, compared to the follicular phase, has a well-documented increase in the incidence of depression, accidents, hospital admission,

suicidal thinking and suicide. The immediate premenstrual and menstrual period in women is associated with an increased frequency of work absenteeism, development of acute psychiatric symptoms, the commission of crimes, accidents, attempted suicide and death by accident or suicide (Mohamadirizi & Kordi, 2013).

On the other hand, less well known is the effect of the menstrual cycle on food intake and eating behaviour. There is a significant cyclic variation in food intake and taste preference during the menstrual cycle. Research discovered that food intake averaged approximately 500 calories more per day during the ten days following ovulation than during the ten days before ovulation (Bryant, Truesdale, & Dye, 2006). This variation in food intake correlates with the oestrogen levels that begin to rise at menstruation, and begin to fall after ovulation (Brien, 1986).

In relation to the differences in carbohydrate, fat, and protein consumption, it has been found that a significant and consistent variation during the menstrual cycle only exists in carbohydrate consumption, not in fat or protein. Women are prone to consume more carbohydrates per day in the postovulatory phase than in the pre-ovulatory phase, while protein intake decreased three days before the onset of menses (Bryant et al., 2006).

Studies found that food intake and body weight were significantly higher during the luteal phase than during the follicular phase with a mean caloric intake in the luteal phase approximately 223 calories greater than the mean caloric intake in the follicular phase, as well as an increase in body weight during the luteal phase (Chung, Bond, & Jarrett, 2010). In addition, the length of the period might affect the consumption of food (Williams, Leidy, Flecker, & Galucci, 2006): short menses females, with menstrual periods less than or equal to five days, had an increased food

intake during the luteal phase, whereas long menses females (menstrual period greater than five days) did not (Hill et al., 1980).

Moreover, a preference for sweetness has been observed in adult human females during the menstrual cycle, especially when short menses are displayed. Short menses females rated sucrose pleasantness significantly higher than their counterparts during phases of the menstrual cycle (Li, Tsang, & Lui, 1999). On the other hand, during the luteal phase of the menstrual cycle, there is a marked decrease in pleasantness ratings, while the follicular phase does not show this decrease (Mioni et al., 2012).

Researchers found that in the luteal (post-ovulatory) phase, excluding the immediate premenstrual period, subjects found sugar solutions significantly less pleasant than subjects tested in other phases of the cycle (menses, pre-ovulatory, ovulatory, and premenstrual). They also found that a significant post-glucose load decrease in perceived sweetness pleasantness occurred in all subjects except those in the ovulatory phase. The observed decrease in sugar preference corresponds to the mid-luteal progesterone peak, and the post-glucose load ovulatory decrease corresponds to the high oestrogen levels (McVay, Copeland, Newman, & Geiselman, 2012; Zellner, Garriga-Trillo, Centeno, & Wadsworth, 2004, Rapino, Marulli, Rapex, Sabatino, & Della Lunga, 1982).

On the other hand, studies of salt preference found "a high degree of intra-individual consistency in salt usage week to week among the women across menstrual phases"(Verma, Mahajan, Mittal, & Ghildiyal, 2005). In addition, studies on taste sensitivity to sourness found that in the majority of women thresholds tended to be significantly lower (more sensitive) during the menstrual period (Bingley, Gitau, & Lovegrove, 2008).

Several investigators have reported alterations in food preference and food intake associated with premenstrual tension syndrome (PMS; Chau, Chang, & Chang, 1998; Craner, Sigmon, Martinson, & McGillicuddy, 2013; Hoyer et al., 2013; Siegel, Myers, & Dineen, 1987). An association between a craving for food and/or sweets and premenstrual feelings of depression or tension has been found, along with an association between craving at specific times and the occurrence of premenstrual fluid retention, the desire to eat compulsively and the tendency to be depressed more frequently (Trout et al., 2008).

Researchers postulated an endorphin withdrawal-mediated aetiology of PMS based on the finding that a decline in beta-endorphin levels correlated with the severity of premenstrual symptoms, supporting an endogenous opiate-mediated mechanism for stress-induced premenstrual increased food intake (Ferrer et al., 1997). In fact, researchers confirmed that women, who reported more severe symptoms, recorded higher caloric intake and that caloric intake during the premenstrual period increased with age (Rosetta, Conde da Silva Fraga, & Mascie-Taylor, 2001).

To conclude, the severity of eating pathology might be related to specific menstrual phases, due to the different effects that hormones have on the body (Klump et al., 2013; McVay et al., 2012).

Ovarian hormones and eating pathology

Ovarian hormones (i.e., oestradiol and progesterone) have been investigated as factors implicated in eating pathology in women, especially in binge eating (Racine & Culbert, 2012), since findings from animal studies demonstrating that ovarian hormones have direct, causal effects on food intake (Asarian & Geary, 2006). For example, removal of ovaries through bilateral ovariectomy in rats causes increased

food intake, and adminstration of oestradiol reverses this effect. In contrast, progesterone causes increased food intake, in part, by antagonizing the inhibitory effects of oestradiol (Klump, Suisman, Culbert & Kashy, 2011).

In humans, studies shows contrasting results: while previous data suggested that lower oestradiol and higher progesterone levels were associated with increases in binge eating and emotional eating (Hildebrandt, Alfano, Tricamo & Pfaff, 2010), other studies indicated that high levels of oestradiol and progesterone were associated with increases of binge eating episodes (Klump & Keel, 2013). Moreover, the association between fluctuation of ovarian hormone and dysregulated eating has been shown to be stronger in women with clinically significant levels of binge eating compared to women without binge episodes (Klump et al., 2014).

Far fewer studies, however, have examined the change of eating pattern across the menstrual cycle considering other variables that might be related to eating pathology, such as weight concern, cravings (Krishnan et al., 2016), bloating (Ahangari, Bäckström, Innala, Andersson & Turkmen, 2015), tiredness (Van Reen & Kiesner, 2016) and menstrual pain (Le Resche, Mancl, Sherman, Gandara & Dworkin, 2003).

The most studied variable was weight concern, showing a correlation between menstrual-cycle fluctuations in ovarian hormone and changes in weight concerns. For example, weight preoccupation levels were highest in the mid-luteal phase due to increases in progesterone and decreases in oestradiol (Racine & Culbert, 2012). However, another study showed that weight preoccupation was highest during the pre-menstrual phase. Reasons for the discrepant results across studies are unclear, although the very small sample sizes of these studies may have contributed to instability in effects (Racine & Culbert, 2012).

Clearly, additional research using larger samples and the inclusion of other variables is needed to determine whether changes in eating intake are due to changes in ovarian hormones, psychological factors (e.g., increased negative affect), and/or other factors (Krishnan et al., 2016; Van Reen & Kiesner, 2016; Ahangari, Bäckström, Innala, Andersson & Turkmen, 2015; Le Resche, Mancl, Sherman, Gandara & Dworkin, 2003).

Polycystic ovarian syndrome

High androgen levels and irregular menses are the main symptomatology of an endocrine disorder that might be connected to eating pathology (especially bulimia nervosa and binge eating disorder): Polycystic Ovarian Syndrome (PCOS; Krepula, Bidzinska-Speichert, Lenarcik, & Tworowska-Bardzinska, 2012).

PCOS is one of the most common endocrine disorders in women of reproductive age. PCOS is diagnosed through the presence of at least two of three criteria: menstrual disorders or amenorrhea with chronic lack of ovulation, clinical and/or biochemical features of hyperandrogenism, and the presence of polycystic ovaries in ultrasonography after the exclusion of other endocrine disorders. Some symptoms of PCOS include: high level of androgens, abnormal levels of FSH and LH, severe acne, skin problems, hirsutism, alopecia and/or thinning hair, irregular or absent periods and increasing weight. Tiny cysts, looking like a string of pearls surrounding the ovary or ovaries, can sometimes be seen on a tense abdominal and trans-vaginal pelvic ultrasound. Some women with PCOS have menstrual disturbances, which include anovulation, due to low level of progesterone, and oligomenorrhea (Shiffman, Farrel, & Yee, 1994).

Women with PCOS seem to struggle with binge eating more often compared to controls for several reasons, both emotional and physiological (Naessen, Carlstrom, Garoff, Glant, & Hirschberg, 2006). Almost all women with PCOS have high levels of insulin (Lunger, Wildt, & Seeber, 2013). Women with a binge eating pattern are also more prone to become resistant to insulin due to their overeating pattern causing defective satiety, decreased resting metabolic rate, and abnormal neuroendocrine regulation (Longobardi, Monteleone, Tortorella, Fabrazzo, & Maj, 2002). High levels of insulin cause hypercortisolaemia, which increases stress and binging patterns (Gati, Tury, Paszthy, Abraham, & Wittmann, 2005). In addition, having too much insulin causes weight gain despite no change in diet or exercise. It can also cause low blood sugar, which then sets up a cascade of events resulting in a strong craving for carbohydrates.

The body craves carbohydrates in an effort to raise blood sugar to normal levels (Peters, Ravestein, Van Der Hijden, Boers, & Mela, 2011). The intense craving for carbohydrates is the result of a metabolic disturbance, quite similar to an alcoholic's craving for alcohol. Additionally, researchers have proposed that insulin may have an appetite-stimulating effect and can perpetuate binge behaviour. During a binge, when large quantities of food are consumed over a relatively short period of time, there is a surge of excess insulin, much more than the one experienced during a normal meal. Chronic binging could, therefore, result in a chronic state of elevated insulin, and when insulin levels become elevated, androgen levels become elevated as well (Brandao et al., 2011). Women with PCOS who engage in binge eating will increase their insulin levels, cause a worsening of their PCOS, and have almost negligible results from treatment for bulimia that does not address this aspect.

Moreover, women with PCOS, because of their hormonal imbalances, may be more prone to mood swings and depression than other women. Their increased testosterone may make some women more aggressive, angry, anxious, and depressed. The dissatisfaction with self-appearance, associated with PCOS, plays an important role in the pathogenesis of eating pathology (Himelein & Thatcher, 2006). Several researchers confirmed this hypothesis: McCluskey found that one-third of 153 women with PCOS fulfilled the diagnostic criteria for eating disorders (McCluskey, Evans, Lacey, Pearce, & Jacobs, 1991). Other studies have shown an increased incidence of polycystic ovaries on ultrasound image in women with bulimia, even after recovery (Morgan, 1999). Morgan studied the prevalence of eating disorders in a group of 80 women with hirsutism, including 68 patients with PCOS. In 36.3% of the women, eating disorders were diagnosed (all the women were from the PCOS group): in 22.5% Eating Disorder Not Otherwise Specified (EDNOS) was recognised, in 12.6% Bulimia Nervosa and in 1.3% anorexia nervosa (Morgan, Scholtz, Lacey, & Conway, 2008). The principal characteristics of PCOS and the possible relationship with eating pathology are shown in Figure 2.

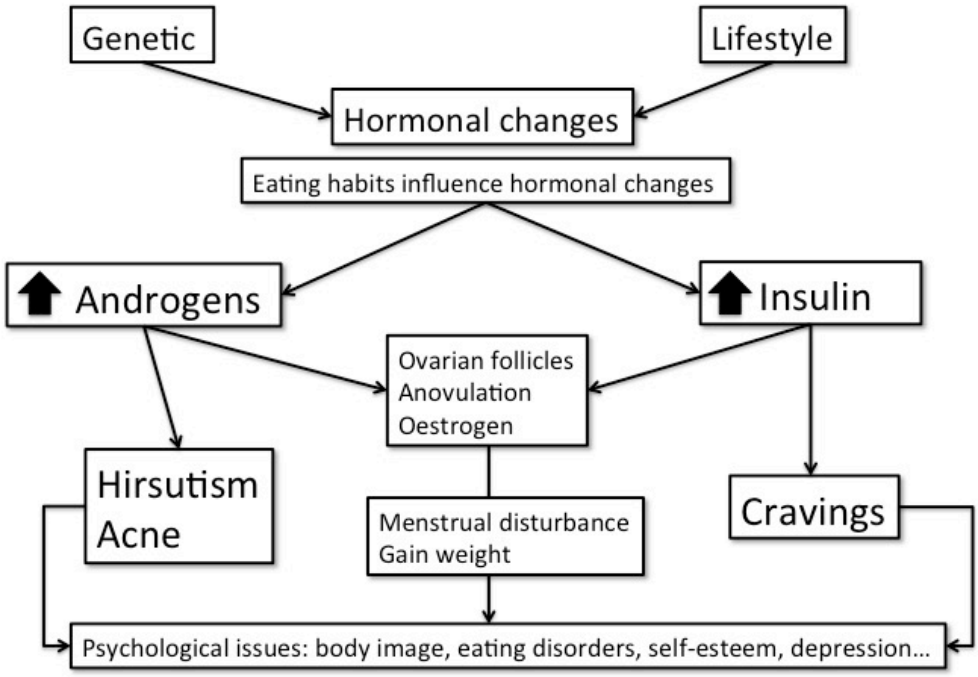

Figure 2. Characteristics of PCOS

To conclude, eating pathology appears to be deeply interrelated with hormonal disorders such as PCOS. Further investigations, with large samples of women, on the link between PCOS and eating pathology would be beneficial in order to develop more comprehensive multivariate models between risk and maintenance factors and the development and perpetuation of both disorders.

Antecedents of eating with Ecological Momentary Assessment

Ecological momentary assessment (EMA) examines the daily experiences, behaviour, and psychological states of individuals in their natural environment (Shiffman, 2009). This method is very similar to experience sampling (Csikszentmihalyi & Larson, 1987) and the daily diary method (Bratteby, Sandhagen, Fan, & Samuelson, 1997) and they all have certain features in common.

Firstly, assessment takes place in participants' natural environments as they go about their daily lives. Secondly, participants complete ratings regarding their current state (e.g., current mood, current behaviour) rather than reporting on mood or behaviours that occurred several days or weeks ago. Finally, EMA involves repeated assessments over time.

Due to the fact that EMA was developed to minimise the recall biases associated with retrospective self-reports, the first two features limit concerns associated with ecological validity and retrospective recall, while the third feature allows examination of variability over time and temporal ordering of the variables in question (Shiffman et al., 2008).

Since research had clearly shown that participants are often not honest about when they report data, electronic devices rather than daily diaries are now used as they allow entries to be date and time stamped, offering a more stable and reliable means of data collection (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002).

EMA allows for the assessment of frequency and patterns of behaviours, thoughts and feelings (Engel et al., 2016) and it has been described as an excellent methodology for studying the behaviours and patterns over time. In particular, it has been particularly used in order to detect how addictions (i.e. smoking) are maintained day by day (Lanza, Piper, & Shiffman, 2014). Thus, it can be a suitable methodology for studying behaviours, experiences and attitudes toward eating (Smyth et al., 2001).

Within the EMA literature on eating pathology, a number of studies have used EMA to measure the frequencies of a wide variety of eating disorder and disordered eating behaviours. For example, EMA has been used to assess the prevalence of eating disorders in samples of women (Stein, Chen, Corte, Keller, & Trabold, 2013); it had also been used to investigate the frequency of binge and purge cognitions

(Shingleton et al., 2013) and the type of social/family interaction in bulimic individials (Okon, Greene, Smith, 2003; Steiger et al., 1999).

EMA-based research has also investigated differences in eating behaviours between diagnoses and sub-diagnoses: for example, the anorexia nervosa binge-purge subtype reported more momentary restrictive eating behaviour than individuals with anorexia nervosa restricting subtype (De Young et al., 2013). EMA studies on bulimia and binge eating showed that on days during which binge eating and purging behaviours both occurred, participants reported significantly greater kilocalorie intake than on days when neither behaviour occurred, or when only binge eating or purging occurred (Burd et al., 2009).

Finally, EMA has been used for investigating behaviours, emotions and situations surrounding anorexia and bulimia nervosa (Goldschmidt, Accurso, et al., 2015). Specifically, EMA studies found an association between negative affect and eating pathology's symptoms (Lavender et al., 2013). Eating disorder sufferers reported significantly higher levels of emotional intensity, lower acceptance of emotions, less emotional awareness and clarity, more self-reported emotional regulation problems, as well as increased use of dysfunctional emotional regulation strategies when compared to healthy controls (Svaldi et al., 2012).

These latter EMA studies on eating behaviours, emotions and situations have investigated mostly bulimia nervosa and binge eating disorder in women. Samples of bulimic and binge eating women showed that the highest rates of binge eating and purging episodes occur on days characterised by high levels of negative affect (Crosby et al., 2009).

Moreover, studies found significant correlations between high levels of negative affect, high level of stress and an increase of binge eating behaviour

frequencies (Smyth et al., 2009; Smyth et al., 2007), associated with a greater likelihood of dietary restriction on subsequent days (Engel et al., 2013; Zunker et al., 2011).

Unfortunately, even though a correlation between eating and negative affect has been found, pinpointing with precision if negative affect has a causal or consequent role to the eating episode is still not clear as the results are often contrasting. For example, some studies reported that negative mood were significantly higher at pre-binge (Berg & Crosby, 2015; Berg et al., 2013) than at non-binge times or post-binge times (Berg & Crosby, 2015; Berg et at., 2013; De Young et al., 2013), while other studies showed that negative mood was still higher at post-binge (Engel et al., 2013; Stein, Kenardy, Wiseman, Dounchis, Arnow, & Wilfley, 2007).

In addition, external cues (such as the social environment) seem to influence the eating pattern (Engel et al., 2016). EMA research on obesity found that eating away from home, social influences, multitasking during meals, and timing of eating occasions were associated with specific types of foods and beverages consumed throughout the day. In particular, a study showed that a large proportion of eating occasions seems to occur alone, while watching TV or engaging in other activities. The eating episodes were completed within a 15-minute timeframe and occurred with virtually no pre-contemplation or planning of food choices or meal selections (Laska, Graham, Moe, Lytle, & Fulkerson, 2011).

Moreover, research shows that a notable proportion of eating occasions occurred later at night. Late night eating events were less likely to include healthier items, such as fruits, vegetables and milk, and more likely to consist of salty snacks (Carels et al., 2001).

Even though, eating pathology has been investigated, literature presents some limitations that the current dissertation aims to overcome. Although the affect regulation model had been examined in relation to binge eating, the result are contrasting especially examining whether negative affect might be an antecedent and/or consequent of eating and whether the affective antecedents of eating differ between different eating disorder subgroups and subclinical eating disorders, such as disordered eating.

In addition, the preponderance of studies on eating pathology was cross-sectional, which precludes statements regarding causality (Brockmeyer et al., 2014; Haynos et al., 2014; Gianini et al., 2013; Espeset et al., 2012; Haedt-Matt & Keel, 2011; Stice et al., 2001).

On the other hand, studies with ecological measures focused mostly on clinical eating disorders (e.g., anorexia nervosa, bulimia nervosa and binge eating disorder; Berg et al., 2015; Goldschmidt et al., 2015; Lavender et al., 2015; Goldschmidt et al., 2014; Berg et al., 2013; De Young et al., 2013; Engel et al., 2013; Goldschmidt et al., 2012; Burd et al., 2009; Crosby et al., 2009), while subclinical eating disordered have not been fully investigated (Heron et al., 2014; Kugu et al., 2006).

Specifically, external cues (such as specific time, location and social environment) that seem to influence the eating pattern, have not fully investigated in subclinical eating disorders, such as disordered eating, with ecological measures (Mekhmoukhet al., 2012; Laska et al., 2011; Lavender et al., 2010; Hetherington et al., 2006). From this point of view, EMA appears to be an excellent methodology to investigate situations, thoughts and cognitive processes, along with emotions, in real

time because it provides information regarding temporal sequencing (Berg et al., 2013).

Aim of the dissertation

Literature shows that there might be a link between eating pathology, emotions and the immediate context (Espeset, Gulliksen, Nordbo, Skarderud, & Holte, 2012). Additionally, there is a distinction between different disordered eating behaviours and the expression of emotions, which is often dysregulated and/or suppressed depending on the sub-diagnosis (Brockmeyer et al., 2014).

Most theories posit a sociocultural vulnerability among individuals with eating disorders and disordered eating, meaning that the exposure to unrealistically thin beauty ideals might contribute to the development of these psychopathologies (Evans, Tovee, Boothroyd, & Drewett, 2013). However, everyone is subject to images of the thin ideal, yet not everyone develops anorexia or bulimia nervosa. Therefore, precipitating aspects are likely to be present, and it appears many of these pertain to the capacity to process, interpret and respond to emotions and affect.

Some of these possible precipitating aspects might be related to the role of emotions in the immediate context (Waters, Hill, & Waller, 2001) and under hormonal/physiological influence (Hildebrandt et al., 2015). They might play an important role in eating pathology, which might be aggravated during times of physical and/or psychological distress (Pearson, Combs, Zapolski, & Smith, 2012).

Unfortunately, once established, an eating pathology is difficult to treat. Some individuals resist treatments and fail to recover from an eating disorder after multiple intervention attempts. Thus, it can be inferred that these pathological behaviours are serving an emotionally functional purpose, as the individual is resistant to change

them (Fassino & Abbate-Daga, 2013). For example, specific disordered eating behaviours, like dietary restriction and binging-purging, might help to regulate emotions at both psychological and biochemical levels (Haynos, Roberto, Martinez, Attia, & Fruzzetti, 2014). Thus, the physiological and emotional rewards of the behaviour support the chronicity of eating pathology.

Despite the large body of literature on eating disorders and disordered eating, research is still lacking information on how biological, psychological and social factors interact (Smolak & Levine, 2015). This inter-relationship between factors might play an important role in precipitating dysfunctional eating behaviours, especially in those people who show a vulnerability in terms of ability to form interpersonal relationships, theorised through the definition of attachment style (Tasca & Balfour, 2014).

The present thesis has the aim of investigating disordered eating considering four different factors in accordance with the biopsychosocial model (Smolak & Levine, 2015): biological (hormonal imbalance, PCOS and menstrual irregularities; Larsson et al., 2016), psychological (negative affect; Berg et al., 2013), social (attachment style and immediate context; Tasca & Balfour, 2014). It has been hypothesised that an inter-relation of factors might be responsible for disordered eating hence they should be studied in concert rather than independently.

This aspect has never been directly investigated: many questions remain to be answered with respect to the implications of attachment style, negative affects, immediate context and the menstrual cycle. For example, the literature suggests that hormonal imbalances are possible triggers in the development of eating disorders (Hildebrandt et al., 2015; Klump et al., 2014; Klump et at., 2013; Ruzika, 2013), but comprehensive research that includes psychological, hormonal and situational factors,

and their interactions when predicting the increase of eating pathology's severity is still missing.

Moreover, emotional and situational antecedents have never been satisfactorily explored in eating pathology compared to studies of addictive behaviours, such as smoking (Piasecki, Trela, Hedeker, & Mermelstein, 2014). Negative affect has been found correlated to eating pathology (Engel et al., 2013; Goldschmidt et al., 2014), but pinpointing with precision if negative affect has a causal or consequent role is still not clear as the results are often contrasting.

In addition, a naturalistic investigation into sub-clinical eating disorders including the role of immediate context in precipitating negative affect has never been performed. The analysis of the role of attachment style in influencing the ability of properly regulate negative affect and its connection with eating pathology has never been directly explored with a combination of retrospective and ecological measures.

In the light of the limitations presented above, literature suggests that a strong link between a dysfunctional attachment style and difficulties in expressing and regulating emotions, especially negative affect, might be present in eating disorders and disordered eating (Dakanalis et al., 2014; Tasca & Balfour, 2014; Ty & Francis, 2013; Cunha et al., 2009). Moreover, hormonal imbalance due to menstrual cycle and/or menstrual irregularities might influence the level of negative affect, precipitating a disordered eating behaviour (Hildebrandt et a., 2015; Hirschberg, 2012). Immediate context might influence the level of negative affect as well, as it might trigger disordered eating behaviours in those who have difficulties in properly regulate negative emotions (Goldschmidt et al., 2015). Hence, the analysis of the possible link between attachment style and negative affect in the immediate context with ecological and retrospective measures might provide useful information on the

maintenance of pathological eating symptomatology, especially in women with menstrual irregularities and/or hormonal imbalance, as Figure 3 shows.

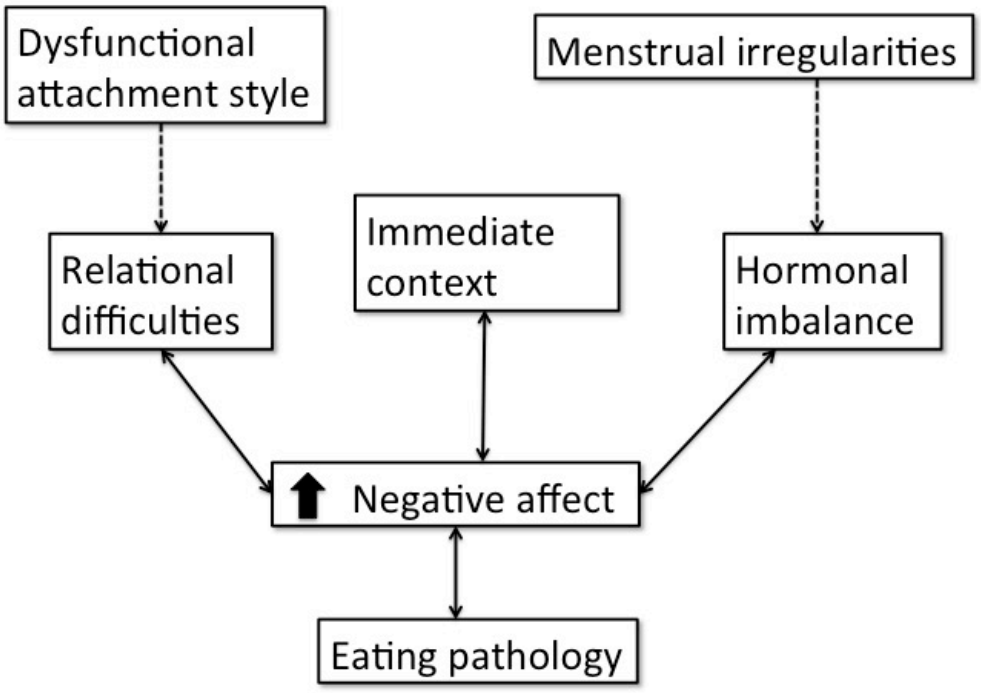

Figure 3. Maps of the thesis showing that a dysfunctional attachment style and menstrual irregularities might cause respectively difficulties in relationships and hormonal imbalance. In conjunction with the immediate context they might be responsible for increasing negative affect that might precipitates eating pathology.

Study 1 and 2: Ecological momentary assessment studies

Introduction

The purpose of these studies was to achieve a better understanding of the inter-relationship between situational, affective and hormonal factors in disordered and healthy eaters in accordance with the biopsychosocial model, suggesting possible triggering and maintaining mechanisms underlying them.

The research further investigates the link between a dysfunctional attachment style, negative affect, immediate context, and disordered eating. Moreover, menstrual irregularities may exacerbate eating pathology (Hildebrandt et al., 2015). For this reason, the psychological and contextual aspects of eating during menstrual cycle have been under examination.

Research design

For the collection of data, the study was conducted using a combination between retrospective and ecological measures [Ecological Momentary Assessment (EMA; also referred to as experience- or event- sampling, or diary methods)] comparing normal eaters with individual with disordered eating in a general population. EMA is recommended for investigating the antecedents to, and consequences of, any repeated behaviour over time and it can be applied to disordered eating in order to examine the eating patterns of the participants (Smyth et al., 2001). Moreover, EMA is able to provide greater insight into possible casual nature of events/experiences in disordered eating because of its sensitivity to the temporal sequence of events and experiences.

EMA involves the participants completing brief questionnaires several times during the day in order to measure experiences, behaviours, emotions or cognitions they experience in their natural environments. Participants typically monitor their experiences several times a day for several days or weeks.

Three types of assessment are utilised: event-contingent, interval-contingent and random prompt recordings. In event-contingent paradigms, participants are asked to complete recordings before and/or after certain events (e.g., before or after a meal), whereas in interval-contingent paradigms, participants are asked to complete recordings at predetermined intervals (e.g., every hour or every night before going to sleep) or in response to signals (e.g., random beeper signals). Random prompt paradigms require participants to complete recordings in response to randomly timed signals. This approach has the advantage of being unpredictable in order to obtain a representative sampling of participants' experiences throughout the day (Wheeler & Reis, 1991).

Event-contingent, interval-contingent and random prompt recording methods can be used to address questions regarding daily fluctuations in factors such as mood or behaviours (Wheeler & Reis, 1991). Researchers have suggested that a combination of interval- event-based and random prompt assessments can strengthen a study's design by assessing variations in processes of interest (with experience-based and random prompt sampling) while being able to assess rare events (with event-based samplings; Bolger, Davis, & Rafaeli, 2003).

Assessments can focus on the immediate experiences (e.g., "the last five minutes" or "right now"), or can elicit recollections of events that occurred over longer timeframes (e.g., "the last 30 minutes" or "since previous recordings"). In either case, EMA methods reduce the recall period (often for days or weeks to

minutes or hours), and thereby reduce biases associated with retrospective recall (Shiffman et al., 2008).

Aside from limiting recall bias, EMA is also believed to improve the ecological validity of reports because it is conducted in the natural environment and facilitates prospective analyses (Stone et al., 1998). Compared to traditional cross-sectional or survey methodologies, EMA is therefore thought to be superior (Shiffman, 2009).

In the present study, a mixed interval/event-contingent/random prompt design has been applied, in which participants provided self-report before and after each eating episode, following random prompts throughout the day and an "end of the day" report. Sampling was achieved utilising electronic self-monitoring diaries, run on an online application developed by the researchers and freely downloaded on personal phones or computers. The application allowed participants to enter their responses directly, and hence eliminated the need for manual data entry. The period of observation was one week, during which participants had to monitor their eating behaviours and subjective experiences of restraint, overeating, cravings, affect and immediate context. Female participants were additionally followed by a two-week EMA procedure, during which they had to monitor their physical and psychological aspects connected to the menstrual cycle.

Prior to the naturalistic investigation, participants also had to complete a series of retrospective measures in which information about attachment style, personality traits and eating disorder diagnoses were drawn. The resulting databases helped to explore hypotheses bearing upon eating antecedents in connection with affective, situational, relational and menstrual aspects in disordered and normal eaters.

Study aims and hypotheses

This dissertation examined the daily eating behaviours, emotions, and contextual situations of 136 normal eaters and individuals with disordered eating in their naturalistic environment.

The current dissertation had two primary aims. The first was to investigate the role of attachment style, negative affect, immediate context and menstrual cycle as possible antecedents of eating in disordered and normal eaters. Longitudinal changes one-hour prior to and after eating and over a one-week period have been investigated.

The second aim was the investigation of the influence of menstrual cycle on eating intake in the females in disordered eating sample and general population.

Study 1

Hypothesis 1: A moderate convergence between the frequency of EDE-Q behaviours and EMA disordered eating behaviours would be more likely to suggest that these distinct assessment approaches are concordant for the variables assessed.

In order to test the validity of ecological measures in detecting dysfunctional behaviours, an examination of the degree of association between the frequency of retrospective disordered eating and the frequency of EMA disordered eating behaviour frequency has been performed to measure the level of concordance between the two approaches.

The timeframe for disordered eating behaviours between retrospective and naturalistic approaches did not overlap. Specifically, retrospective measures (EDE-Q6) assessed the frequency of behaviour over the previous 28 days, while EMA measured the frequency of behaviours during the one-week EMA protocol, which was subsequent to the 28-day period assessed via EDE-Q6. It has been hypothesised there

would be a moderate convergence between the frequency of EDE-Q behaviours and EMA disordered eating behaviours suggesting that these distinct assessment approaches were concordant for the variables assessed (Wonderlich et al., 2015). This means that there was a moderate consistency in the frequency of disordered eating behaviours over time, ranging from one week to 28 days. Hence, these behaviours have a relative stability and both measures are valid assessments of the frequency of disordered eating symptoms and behaviours frequency.

Hypothesis 2: Disordered eating participants would be more likely to skip meals, eat less, and lose control over eating more than controls.

Hypothesis two states that there might be a significant difference between eating and non-eating episodes in individuals with disordered eating and in controls in terms of quantity eaten, type of meal, loss of control, hunger level. Specifically, disordered eating participants would be more likely to skip meals, eat less, and lose control over eating more than controls (Berg et al., 2013; Goldschmidt et al., 2012).

Hypothesis 3: Negative affect would be more likely to be higher in the disordered eating sample than controls, both in ecological and retrospective measures and a dysfunctional attachment style would be more likely to precipitate current negative affect in the disordered eating sample.

Negative affect was investigated in order to understand which type of negative feelings mostly predicted disordered eating symptomatology. Moreover, the possible association between ecological negative affect, retrospective measures of disordered eating symptomatology and attachment style has been analysed. It was hypothesised that when examined independently and controlling for relevant covariates (gender,

age, education and ethnicity), measures of different emotions accounted for a significant proportion of the variance in disordered eating measures (Gianini et al., 2013). In addition, attachment style might play a unique role in the relationship between negative affect and disordered eating. For example, it might play a role in precipitating current negative affect and the severity of the disordered eating symptomatology (Tasca & Balfour, 2014).

Hypothesis 4: Specific facets of negative affect and immediate context would be more likely to precede an eating episode in the disordered eating sample. In particular, guilt, shame, anger and immediate context of being in a familiar environment and in absence of others would be more likely to be seen as antecedents of eating in the disordered eating sample.

The literature suggested that antecedents and consequents play an important causal role in eating disorders and disordered eating (Novak & Dostal, 2008). For example, the literature showed that negative affect might be a precipitant and a consequence of disordered eating (Engel et al., 2013). In particular, we hypothesise that negative affect states would predict an eating episode in the disordered eating sample.

Moreover, facets of negative affect could be differentially related to disordered eating (Berg et al., 2013). For example, the literature suggests that eating disorder and disordered eating sufferers seem to experience higher levels of shame, guilt and anger prior to eating, compared to healthy controls (Waters et al., 2001). Thus, we expected to find that these facets of negative affect would increase prior to eating in disordered eating sample compared to controls.

In addition, situational antecedents of eating might be different in disordered eating participants compared to healthy eaters, meaning that certain situations might be responsible for triggering eating behaviours in disordered eating sufferers (Liao et al., 2015). We hypothesised that disordered eating participants would be more prone to eat in specific situations, such as being in familiar situations (i.e., at home; Liao et al., 2015) and in absence of other (Tani et al., 2015).

Hypothesis 5a: Negative affect would be more likely to rise one hour before eating in the disordered eating sample compared to controls.

Hypothesis 5b: There would be a significant difference between the disordered eating sample and controls in the level of negative affect facets before and after eating episodes, and over the seven-day. Specifically, guilt and anger would be higher than the other facts of negative affect in DE participants compared to controls.

In support of these hypotheses, the literature affirmed that negative affect was usually higher before rather than after eating in eating disorders and disordered eating (Engel et al., 2013). Thus, we hypothesise that negative affect would more likely to rise one hour before eating in the disordered eating sample compared to controls.

Additionally, the literature indicates that each negative affect facet plays a different role in disordered eating. The literature showed that items related to the factor "Hostility" and "Guilt" seemed to play a role in precipitating disordered eating behaviours. In particular, Guilt compared to other facets retained significant linear effects before and after eating disorder and disordered eating behaviours, when controlling for the other facets of negative affect (Berg et al., 2013).

Thus, we hypothesised that negative affect facets would have different trends before and after eating episodes, and over the seven-day period with a significant

difference between individuals with disordered eating and controls (Racine et al., 2013; Berg et al., 2013).

Summary of hypotheses in Study 1

Hypothesis 1: A moderate convergence between the frequency of EDE-Q behaviours and EMA disordered eating behaviours would be more likely to suggest that these distinct assessment approaches are concordant for the variables assessed.

Hypothesis 2: Disordered eating participants would be more likely to display higher levels of negative affect compared to healthy controls and they will be more likely to skip meals, eat less, lose control over eating more than controls.

Hypothesis 3: Negative affect would be more likely to be higher in the disordered eating sample compared to controls, both in ecological and retrospective measures and a dysfunctional attachment style would be more likely to precipitate current negative affect in the disordered eating sample.

Hypothesis 4: Specific facets of negative affect and immediate context would be more likely to precede an eating episode in the disordered eating sample. In particular, guilt, shame, anger and immediate context of being in a familiar environment and in absence of others would be more likely to be seen as antecedents of eating in the disordered eating sample.

Hypothesis 5a: Negative affect would be more likely to rise one hour before eating in the disordered eating sample compared to controls.

Hypothesis 5b: There would be a significant difference between the disordered eating sample and controls in the level of negative affect facets before and after eating episodes, and over the seven-day. Specifically, guilt and anger would be higher than the other facts of negative affect in DE participants compared to controls.

Study 2

Hypothesis 1: Disordered eating sufferers would be more likely to experience menstrual irregularities and dysfunction (e.g., PCOS) than controls.

Study 2 aimed to analyse the relationship between disordered eating symptomatology and the menstrual cycle. Due to the fact that the menstrual cycle influences sexual hormones (Klump et al., 2013), menstruation might have a direct effect on the level of hunger and food intake (Hirschberg, 2012). Usually, eating disorder and disordered eating sufferers experience menstrual irregularities and dysfunction (for example, amenorrhea in anorexia nervosa and/or PCOS in bulimia nervosa and binge eating disorder; Algars et al., 2014; Mehler & Brown, 2015).

Hypothesis 2: A significant increase in the level of typical symptoms associated with menstruation (such as cravings, bloating, breast sensitivity/tension, headache, fatigue and feelings of anxiety/sadness) would be more likely to be experienced by disordered eating participants compared to healthy controls.

From the literature, it seems that eating disorder and disordered eating participants suffer more of the typical symptoms associated with menstruation, such as cravings, bloating, breast sensitivity/tension, headache, fatigue and feeling of anxiety/sadness. This might mean that a dysfunctional eating pattern commonly found in eating disorders and disordered eating might worsen the typical symptoms associated with menstruation (Kimmel, Ferguson, Zerwas, Bulik, & Meltzer-Brody, 2016; Nobles et al., 2016).

Hence, we hypothesised that people with disordered eating will experience those symptoms more acutely and more discomfortingly than healthy controls (Hildebrandt et al., 2015). In particular, disordered eating participants would be more likely to experience more cravings, sensations of bloating, physical pain, higher levels of anxiety, sadness, anger, fatigue, mood swings, breast sensitivity/tension and headaches than controls.

This means that disordered eating participants might be more prone to changing their eating pattern with the purpose of reducing those symptoms (i.e., dieting in order to reduce bloating; Lester, Keel, & Lipson, 2003) and they would be more likely to display a more acute mental and physical discomfort before or during their menstrual cycle compared to controls.

Summary hypotheses in Study 2

Hypothesis 1: Disordered eating sufferers would be more likely to experience menstrual irregularities and dysfunctions (e.g., PCOS) compared to controls.

Hypothesis 2: A significant increase in the level of typical symptoms associated with menstruation (such as cravings, bloating, breast sensitivity/tension, headache, fatigue and feelings of anxiety/sadness) would be more likely to be experienced by disordered eating participants compared to healthy controls.

Measures

Assessment of transient changes in negative affect, specific social-relational antecedents, the menstrual cycle and eating behaviours was accomplished using an electronic self-monitoring diary.

In this present investigation, the approach used to establish the validity and reliability of state measures was adapted from previous diary-based research (Stein, Kenardy, Wiseman, Dounchis, Arnow, & Wilfley, 2007; Damberg et al., 2005; Ek, Palmberg, Sundblad, & Larsson, 2005; Elmore & Decastro, 1990; Lingswiler, Crowther, & Stephens, 1989; Johnson & Larson, 1982). In addition, this investigation included standardised questionnaires used to assess eating disorder symptomatology, menstrual pattern and attachment style.

Eating Disorders Examination-Questionnaire (EDE-Q6). The EDE-Q6 (Fairburn & Cooper, 1993) is a questionnaire that evaluates the presence and severity of eating disorder symptoms. It was utilised in the present study to confirm the presence of eating disorder symptoms. Reported inter-rater reliability on the EDE-Q6 is high (correlation coefficients exceed .90 for all but one item), and alpha coefficients for the subscales of the EDE-Q6 range from .68 to .90 (Fairburn & Beglin, 1994). The EDE-Q6 effectively discriminates between eating disordered patients and normal controls, dieters and overweight people (Pelaez-Fernandez, Labrador, & Raich, 2012).

The Experiences in Close Relationship-Revised (ECR-R) Questionnaire (Fraley, Waller, & Brennan, 2000). The Experiences in Close Relationships-Revised (ECR-R) questionnaire is the revised version of Brennan, Clark, and Shaver's (1998) Experiences in Close Relationships (ECR) questionnaire. The items are selected using

techniques based on Item Response Theory from the same ECR items pool. Both ECR and ECR-R are designed to assess individual differences about attachment-related anxiety (i.e., the extent to which people are insecure or secure about the availability and responsiveness of romantic partners) and attachment-related avoidance (i.e., the extent to which people are uncomfortable being close to others or secure in depending on others) with an internal consistency/reliability of .90 or higher for both scales (attachment-related anxiety and attachment-related avoidance; Fraley, Heffernan, Vicary, & Brumbaugh, 2011).

Patient Medical History Questionnaire. The Patient Medical History Questionnaire (PMHQ) is a self-administered questionnaire used in general medical clinics in order to collect information about medical history. The reliability and validity of the responses are tested statistically. Test-retest reliability of patients' responses to the questionnaire was 90 per cent. More than 92 per cent of the patients' written responses to health history items agreed with the data obtained in a blinded fashion by internists in the traditional interview. The questionnaire accurately obtains items of history frequently missing from the recorded ambulatory care database, and in some instances obtains items of history more effectively than the interviewing physician (Pincus & Yazici, 2006).

Electronic Self-Monitoring Diary. A novel self-monitoring diary application software was developed specifically for the study. The application software was freely available for download on personal devices with the purpose of recording behaviours, situations and feelings of interest. The application software was programmed to emit a beeping sound several times per day to remind participants to

record their meal and at the end of the day for a final assessment. Moreover, the application was programmed to beep randomly during the day, asking questions regarding eating behaviour, mood and situations. The hour and date are automatically recorded for all samplings. Three types of record are present in the software application:

1. *Events records*. Participants had to record every eating episode (at the time of eating and after that), indicating the type of meal (1 Breakfast, 2 Morning snack, 3 Lunch, 4 Afternoon snack, 5 Dinner, 6 N/A Random eating), the subjective perception of the amount eaten and the perceived loss of control during the episode. These data allowed us to discriminate a binge from a normal overeating episode, in accordance with the definition of binge: an episode of overeating in which (a) the consumption of a large amount of food is present, and (b) during which there is a loss of control over eating (i.e., a feeling of not being able to stop eating or control the amount eaten). The electronic diary included items to assess the level of hunger, negative affect from PANAS X and Stein (Stein, Kenardy, Wiseman, Dounchis, Arnow, & Wilfley, 2007; Watson, & Clark, 1994; Watson, Clark, & Tellegen, 1988) and the situation in which the participants were (with questions about where they are, what they are doing and who they are with) from Stein et al. (2007). Seven items from the PANAS X and Stein (2007) were chosen to assess momentary negative affect (NA): dissatisfied with self, envious, ashamed, disgusted, angry, lonely and guilty. Participants were asked to rate the extent to which they currently felt these emotions on a continuous scale, ranging from 0 (not at

all) to 100 (extremely). The internal consistency of this abbreviated negative affect (NA) scale (α = .87) was consistent with the internal consistency of the full negative affect (NA) scale when assessed at the momentary level (range of αs = .85-.91; Watson, & Clark, 1994; Watson et al., 1988). The quantity of food eaten was self-monitored asking directly the subjective perception of the amount of food eaten (too much, adequate or not enough). Similarly, the loss of control was measured asking the participants directly if they perceived a loss of control during the eating episode. In order to assess the specific situation during the episode, multiple-choice questions inquired about the activity (1 Resting/ relaxing, 2 Socialising, 3 Working, 4 Exercising, 5 Others), the relationship (1 Alone, 2 Partner, 3 Friends, 4 Family, 5 Co-workers, 6 Others) and location (1 Home, 2 Car, 3 Restaurant/cafe, 4 Work/School, 5 Outside, 6 Others; Stein, Kenardy, Wiseman, Dounchis, Arnow, & Wilfley, 2007).

2. *Random prompt record*. In order to record non-eating episodes, non-eating alarm entries were initiated by an audible alarm every 3 hours during waking hours, resulting in approximately five/six alarms per day. Participants were asked about their affect and hunger levels on a scale from 0 to 100. Moreover, they were asked about their activity (1 Resting/ relaxing, 2 Socialising, 3 Working, 4 Exercising, 5 Others), any relationship presence (1 Alone, 2 Partner, 3 Friends, 4 Family, 5 Co-workers, 6 Others) and location (1 Home, 2 Car, 3 Restaurant/cafe, 4 Work/School, 5 Outside, 6 Others). Questions were adapted from PANAS

X and Stein (Stein, Kenardy, Wiseman, Dounchis, Arnow, & Wilfley, 2007; Watson et al., 1988).

3. Menstruation Self-Monitoring Diary. At the end of each day, female participants were asked to record their menstrual pattern. Menstruation patterns and symptomatology related to the menstrual cycle were assessed using the Menstrual Symptom Questionnaire (Negriff, Dorn, Hillman, & Huang, 2009), which included questions about cravings, bloating, body aches, sadness, anxiety, anger, mood swings, breast sensitivity/tension, headaches, hormonal medication and menstruation timing. Items were placed on a scale from 1 to 100 with higher scores reflecting strong symptoms.

Procedure

Participants (N=136) were recruited from the general population and outpatient services in Eating Disorders Clinics or associations. In particular, participants with disordered eating (N=55) and healthy controls (N=81) were recruited from Medical Clinics (Brunswick Central Medical Centre, Georgy Medical Clinic, Sia Medical Clinics and Werribee Health Care Group Medical Clinics), Eating disorders clinics and associations (Eating Disorders Victoria and Butterfly Foundation) and from the campus and surrounding community populations of University of Melbourne.

The research took place entirely online in order to overcome feelings of shame and guilt around the disorders (Jacobi, Volker, Trockel, & Taylor, 2012), which might prevent participants from taking part in the research or might decrease their compliance.

Every site used identical protocols for recruitment, screening, and data collection. Recruitment methods included posters and advertisements that invited men and women to participate in a study of their daily eating experiences.

Participants completed an online eligibility screen through Qualtrics website (http://www.qualtrics.com/), where they received additional information about the research. They were asked to complete the consent form and to fill out three questionnaires: Eating Disorder Examination Questionnaire (EDE-Q6), Experiences in Close Relationships-revised (ECR-R) and Patient Medical History Questionnaire. Inclusion criteria were: be able to read and write English, be willing to give their consent to and complete the research tasks, be over 18 years old and, if female, not be pregnant.

All recruitment methods were followed by a confidential screen to assess initial eligibility, determined whether potential participants appeared to meet study criteria. Disordered eating participants were drawn using the Eating Disorder Examination Questionnaire (EDE-Q6) with a cut off score of 2.50, which the literature used to detect subclinical eating disorders (such as disordered eating) in the general population as it provides a diagnostic impression of the study sample (Aardoom et al., 2016; Ro, Reas, & Stedal, 2015). Information about attachment styles and the participants' medical history was gathered from the Experiences in Close Relationships-revised (ECR-R) Questionnaire and Patient Medical History. This assessment took 5 to 10 minutes to complete.

If the individual appeared to be eligible, a confidential email was sent. Participants were invited to follow a link in order to register themselves via a website and they were allowed to download a Desktop, IPhone, or Android application. They were invited to complete EMA protocols on their personal device for one week with an additional week for females in order to gather additional information about their menstrual cycle.

Of the 179 participants who completed the questionnaires, 4 participants were not eligible because underage, 8 of them did not provide a correct email address, 9 participants never registered to the app, 4 participants withdrew before starting the EMA protocol and 18 participants never logged any meal in the app.

The remaining 136 participants are included in data analyses. The EMA questionnaires and the alarm mechanisms were developed in PHP with the support of the Code Igniter (http://codeigniter.com/) framework. The electronic diaries were administered through an online application, available for download on PC (desktop) and Android/Apple mobile devices. Participants were prompted to enter data through

a form with either a touch-based interface (on touch capable mobile devices) or through mouse/keyboard interaction. Participants were able to access the application whenever they wanted while being reminded of their entry tasks through push notifications (on push notifications capable devices) or through desktop notifications. Notifications were randomly spawned inside four different timeframes (from 8 to 11am; from 12 to 14pm; from 15 to 17pm; from 17 to 21pm). Answers were collected as alphanumerical values, acting as keys for the questions/answers pairs outlined in the EMA protocol file. All the users' data were stored in a MySQL database, one of the most commonly used relational database management systems. This technology allowed the acquisition of feedback in real time; as soon as a participant completed the EMA assessments, the system marked it as such, allowing the custom tools to store the results.

During the seven-day period under observation, participants provided two types of ratings: (a) non-eating alarm entries and (b) self-initiated entries for each time they were eating. Non-eating alarm entries took approximately 1-2 minutes. These entries included questions about the participants' level of hunger, affect and situation. Non-eating alarm entries were initiated by an audible alarm approximately every 3 hours during waking hours resulting in approximately five/six alarms per day. If the participant did not respond within two minutes after the alarm sounded, the application provided the option to choose "snooze" (the alarm would sound five minutes later), "skip" (the missed alarm was recorded), or "answer". Participants were allowed to turn off the audible alarm for short periods of time (max 2 hours) during the day when it might be dangerous (e.g., driving) or inappropriate (e.g., work meeting) to respond. Participants were allowed to choose how long to temporarily turn off the audible alarm and the alarm did not require any reactivation by the

participants as it resumed automatically after 2 hours. For all the alarm entries, participants were asked if they were in the middle of eating. If so, the reading was terminated.

Participants were also requested to initiate electronic diary readings at the time of eating and after that. Full assessment entries took approximately 2-3 minutes. Initiated entries included specific questions about the level of hunger, the quantity eaten, the affect and the current situation participants were in. Participants were compensated for their time and effort by being entered in a competition to win an iPad Mini.

The progress of the research project was monitored with custom software, developed in PHP with the support of the "Code Igniter" (http://codeigniter.com/) framework, to leverage its security and database abstraction features with the highest priority being the security of the system. All the user data was stored in a MySQL table, one of the most commonly used RDBMS databases. This technology allowed us to get feedback in real time; as soon as a participant completed the EMA assessments, the system marked it as such, allowing our custom tools to analyse the results. This was a dynamic system that allowed us to examine at the results as they were shaped.

This study was approved by the University of Tasmania Research Ethics Board.

Data analysis

The research aimed to collect data from participants in their natural environment as close to real time as possible using EMA. The methodological approach suitable for Intensive Longitudinal Data (IDL) study designs was the Time-Varying Effect Model (TVEM; Ballinger, 2008).

TVEM is a statistical approach, useful to explore the time-varying relations between intensively measured continuous variables (time-varying effect covariates) and a specific time-varying outcome (in this case, disordered eating; Tan, Shiyko, Li, Li, & Dierker, 2012). Data has a multilevel structure: different occasions are nested within individuals, who are themselves nested within groups (disordered eating individuals versus control).

Effects do not only vary across time points but also between individuals. Different people may be affected differently by certain situations. For example, the relationship between mood and eating may change over time and vary across individuals because some people eat in enjoyable social situations while others eat when they are alone and under stress. Therefore, the structure of the error process changes over time. The error variance may dramatically change over time, making the classic linear modelling assumption of a constant variance term untenable. Time-varying effect models (TVEMs) are a natural extension of linear regression models, with the inclusion of time as a repeated measure.

First of all, a two-level confirmatory factor analysis with random intercept was performed on the EMA data to evaluate the factor structure of the PANAS-X and Stein (2007) negative scale. Model fit was evaluated using the confirmatory fit index (CFI), the Tucker–Lewis index (TLI) and the root-mean-square error of

approximation (RMSEA). To examine whether the model varied over the one-week period, we included time as a covariate.

Secondly, a series of multiple regression and hierarchical regressions were conducted to examine which type of negative feelings and which type of attachment style was predictive of eating disordered measure (EDE-Q6 total scale) and at what extent, controlling for diagnosis, gender and BMI. These particular covariates were selected because they represent constructs theoretically relevant to eating disorders and disordered eating symptom measures; thus, controlling for these variables provided a strong test of the unique contribution from the emotion-related and attachment style variables.

Thirdly, due to the presence of repeated categorical, correlated and clustered responses, a within-subject design was adopted to address whether antecedent and consequent conditions varied for disordered eating participants compared to controls. The individual observations were the unit of analysis: the self-initiated participant EMA entries at eating and non-eating alarm entries were analysed. To account for the nesting of multiple categorical observations within subjects, data were analysed using logistic generalised estimating equations (GEE) with a binary logit link function and autoregressive correlation. This analysis considered each EMA entry occasion (eating vs. non-eating) as a categorical dependent variable modelled as a function of situational variable (e.g., affect and situation).

Moreover, a repeated measure MANOVA and paired-sample t-tests were performed to test if there was a significant difference in the level of negative affect at the time of eating and after in the disordered eating sample. MANOVA was used because it takes into account the intercorrelations among the dependent variables and protects against inflated Type 1 error caused by conducting multiple repeated measure

t-tests. This model was considered appropriate and beneficial to use since (i) it allowed the examination of the relationship between one dichotomous variable (eating/non-eating episodes, pre-/post-eating episodes) and continuous variables (affect); and (ii) it allowed the examination of the relationship between one dichotomous variable (eating/non-eating episodes) and ordinal variables (situations).

A mixed model design has been used to investigate the level of negative affect variables one hour before and after each eating episode. The last random prompt before each eating episode and the first random prompt after were the units of the analysis. Mixed models analyses have been used because they are flexible and robust with respect to handling missing data and unbalanced design in repeated-measures research. They offer the benefit of estimation maximisation, which provides joint modelling for each individual for observed and missing data based on maximising the likelihood for population parameter as a function of observed data. Thus, all participants (regardless of missing data at one or more assessment points) have been included in the analyses and estimates are obtained, as opposed to missing cases being omitted as is the case with traditional analyses of variance.

In addition, a Repeated Measure ANOVA using a mixed linear model and 3-ways mixed ANOVA (with time as repeated measure) have been used for investigating the time-varying effect of the variables over time. A Repeated Measured ANOVA with Greenhouse-Geisser (Weinfurt, 2000) correction was conducted to determine whether there was a significant main effect of diagnostic group and time, and their interactions on the level of negative affect variables in a mixed within-between design. Diagnostic group (disordered eating individuals/control) was the between-subject variable with two levels and time was a within-subject variable with 7 levels (Day 1, Day 2, Day 3, Day 4, Day 5, Day 6, Day 7 and Day 8). The model

used restricted maximum likelihood estimates and a compound symmetry error structure because of the repeated measure of the data.

On the other hand a three-ways mixed ANOVA (Stevens, 2007; with time as a repeated measure) was performed for examining the interaction between two between-subjects factors [(disordered eating individuals versus controls) and (menstruating versus non-menstruating)] and a within-subjects factor (time) on dependent variables (cravings, bloating, physical pain, anxiety level, sadness, anger, fatigue, mood swing, breast sensitivity/tension and headaches)].

All the analyses were conducted utilizing SPSS version 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) and AMOS 24 (Arbuckle, J. L. (2014); Amos (Version 23.0) [Computer Program]. Chicago: IBM SPSS).

Subjectivity and biases

Ecological Momentary Assessments present some limitations and cannot be completely objective and free of all biases. In this study, the researchers attempted to guard against subjective biases recording all data through the use of a computerised application (Thomas, 1973). Nevertheless, all behavioural assessment procedures are obtrusive (Kern, 1984): the subjects were aware that their behaviour was under assessment.

The potential problem with obtrusive assessment is that it might affect how subjects perform (De Korte, Huysmans, De Jong, Van De Ven, & Ruijsendaal, 2012). This aspect has not always been a source of bias; if the research is testing changes of target behaviour, obtrusive assessment is very useful since it helps to actually produce changes in behaviour.

On the other hand, if the focus of the research is the recording of a specific behaviour without the will to modify it, obtrusive assessments provides information that needs to be supplemented whenever possible with unobtrusive measures, in order to make the target behaviour less reactive. This study took into account this aspect, due to the conjoint utilisation of retrospective and ecological measures. Moreover, the utilisation of the participants' personal devices for EMA assessments was a less intrusive approach than traditional behavioural assessment procedures (Ivorra, Daniels, & Rubinsky, 2008).

Results

Study 1

Characteristics of the sample

The sample (N = 136) consisted of 55 individuals with disordered eating (DE) and 81 healthy controls. There was a significant difference between the groups in the distribution of male (N = 46) and female (N = 90) participants, p = .039. Participants ranged in age from 18 to 43 years (Median = 29 years). They reported their ethnicity (N =136): 85 (62.5%) identified themselves as Caucasian, 16 (11.8%) as Asian, 15 (11%) as Black or Africans, 7 (5.1%) as Middle Eastern and 13 (9%) as other ethnicities or Aboriginal.

Participants reported their education level (N = 136); 57 participants (41.9%) had completed tertiary education, 53 (37.5%) had completed postgraduate studies, 18 (13.2%) had completed secondary studies and 8 (5.9%) had completed primary studies. In order to assess the group differences in these variables, Chi Square (for categorical and ordinal variables) tests have been performed due to the non-normality of the data. Frequencies of baseline characteristics for each group have been reported in Table 3.

Table 3. Participants' socio-demographics

	DE N=55	%	Controls N=81	%	Chi square	Df	P
Gender					4.2	1	**.039**
Female	42	76.4	48	59.3			
Male	13	23.6	33	40.7			
Ethnicity					10.5	5	.062
Caucasian	27	49.1	58	71.6			
Aboriginal	1	1.8	0	0			
Asian	11	20	5	6.2			
Middle Eastern	3	5.5	4	4.9			
Black	8	14.5	7	8.6			
Others	5	9.1	7	8.6			
Education					16.5	3	**.001**
Primary	8	15.1	0	0			
Secondary	10	18.9	8	9.9			
Tertiary	19	35.8	38	46.9			
Postgraduate	16	30.2	35	43.2			

Results indicated that the number of females was significantly higher than the number of males in the DE group (Gender p = .039) and controls display higher levels of education than DE (Education p = .001).

In addition, the analysis of differences between groups in disordered eating levels, attachment style, BMI, and age were performed for all the participants. To assess the level of disordered eating, EDE-Q6 total scale (EDE-total) and subscales (EDE-restraint scale, EDE-eating concern scale, EDE-shape concern scale and EDE-weight concern scale) were calculated for all participants. Attachment scales (ECR-anxiety scale and ECR-avoidance scale) were calculated for all the participants to detect the type of attachment style (anxious or avoidant). Due to the violation of normality, median, range and Mann-Whitney U test have been performed and the results are reported in Table 4.

Table 4. Baseline measures: medians, range and Mann-Whitney U

Variable	DE N=55		Control N=81		U	p
	Median	Range	Median	Range		
Age	29	18-39	29	21-43	1608.00	.416
EDE total	3.7	2.6-5.6	1.5	1.03-2.26	.00	< .001
EDE-restraint scale	4.4	2.2-7	1.4	1-3.6	66.00	< .001
EDE- eating concern scale	3.6	1-5.6	1.2	1-2.4	109.00	< .001
EDE – shape concern scale	3.5	2-5.5	1.75	1-2.9	63.50	< .001
EDE – weight concern scale	3.4	0-5.2	1.4	1-3	229.00	< .001
ECR – anxiety scale	4.2	1.2-6.9	2.9	1-5.6	809.00	< .001
ECR – avoidance scale	4	1.1-6.6	3.3	1.6-5.9	1093.00	< .001
BMI	21.2	16.2-29.1	21.7	18.2-31	801.00	.357

As expected, the DE group had significantly higher scores on the EDE-Q6 total scale (Median = 3.7, Range = 2.6-5.6) compared to controls (Median = 1.5, Range = 1-2.26), p = < .001. On the other hand, results showed that controls did not significantly differ from the DE group in the level of "Age" and "BMI". The median age was 29 years old and the median BMI was 21.45 in both groups.

Moreover, the DE group had significantly higher scores on the ECR anxiety scale (Median = 4.2, Range = 1.2-6.7) compared to Controls (Median = 2.5, Range = 1-5.6), U = 809, p = < .001. Likewise, DE subjects obtained significantly higher scores on the ECR avoidance scale (Median = 4, Range = 1.1-6.6) compared to controls (Median = 3.3, Range = 1.6-5.9), U = 1093, p = < .001. This means that DE

individuals were more likely to display a dysfunctional attachment style (anxious and/or avoidant) compared to controls.

Given the heterogeneous nature of the disordered eating sample, more information about their disordered eating behaviours has been provided in Table 5.

Table 5. Frequency of disordered eating behaviours in disordered eating sample (N = 55)

Variables	0 days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every days
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Dieting	2 (3.6)	11 (20)	7 (12.7)	9 (16.4)	7 (12.7)	8 (14.5)	11 (20)
Fasting (at least 8 hours)	5 (9.1)	9 (16.4)	6 (10.9)	10 (18.2)	12 (21.8)	8 (14.5)	5 (9.1)
Exclusion of certain kind of food	2 (3.7)	2 (3.7)	6 (11.1)	19 (35.2)	7 (13)	8 (14.8)	10 (18.5)
Rules about food	4 (7.3)	6 (10.9)	5 (9.1)	10 (18.2)	8 (14.5)	13 (23.6)	9 (16.4)
Desire of having an empty stomach	7 (13)	3 (5.6)	10 (18.5)	9 (16.7)	12 (22.2)	2 (3.7)	11 (20.4)
Desire of having a flat stomach	4 (7.3)	3 (5.5)	4 (7.3)	14 (25.5)	9 (16.4)	8 (14.5)	13 (23.6)
Thinking about food	7 (13)	7 (13)	6 (11.1)	11 (20.4)	7 (13)	5 (9.3)	11 (20.4)
Thinking about weight	5 (9.4)	5 (9.4)	14 (26.4)	11 (20.8)	5 (9.4)	4 (7.5)	9 (17)
Fear of losing control over eating	4 (7.5)	7 (13.2)	7 (13.2)	10 (18.9)	7 (13.2)	7 (13.2)	11 (20.8)
Fear of gaining weight	4 (7.4)	8 (14.8)	5 (9.3)	7 (13)	10 (18.5)	7 (13)	13 (24.1)
Feeling fat	3 (5.7)	1 (1.9)	2 (3.8)	12 (22.6)	7 (13.2)	11 (20.1)	17 (32.1)
Overeating episodes	9 (17.6)	29 (56.9)	10 (19.6)	0 (0)	2 (3.6)	0 (0)	1 (2)
Losing control over eating episodes	8 (15.7)	31 (60.8)	8 (15.7)	0 (0)	1 (2)	1 (2)	2 (3.9)
Days of overeating	17 (33.3)	28 (54.9)	5 (9.8)	0 (0)	1 (2)	0 (0)	0 (0)
Purging episodes	34 (69.4)	9 (18.4)	3 (6.1)	0 (0)	2 (4.1)	0 (0)	1 (2)
Laxative misuse episodes	35 (72.9)	11 (22.9)	2 (4.2)	0 (0)	0 (0)	0 (0)	0 (0)
Compulsively exercising episodes	27 (55.1)	11 (22.4)	7 (14.3)	1 (2)	1 (2)	0 (0)	2 (4.1)

Table 5 presents the frequency of disordered eating behaviours in the disordered eating sample. While 20% of the sample was dieting every day; fasting (8 waking hours or more) was displayed by the 21.8% of the sample at least 16 days in a month. The 18% of the sample was excluding food from their diet every day and

23.6% applies rules about food (e.g., eating a certain amount of calories) at least 23 days in a month. Moreover, the 22.2% and the 25.5% of the sample desired to have an empty and a flat stomach at least 16 and 13 days in a month respectively. The 20.4% of the total sample was thinking about food every day and the 26.4% was thinking about weight and shape at least 6 days in a month. The 20.8% of the sample was scared of losing control over food every day; the 24.1% of the sample had a constant fear of gaining weight, while the 32.1% of the sample felt constantly to be fat.

More than 50% of the sample had episodes of overeating between 1 and 5 days per month, while the 60.8% of the sample was scared to lose control over food between 1 and 5 days per month. The majority of the sample did not display purging episodes, nor laxative misuse or compulsive exercising.

Quality of EMA data

7,609 momentary ratings were completed. They included 4,755 event contingent ratings and 2854 random signal ratings. Participants' compliance rates were calculated by dividing the number of completed entries by the total number of signals that were prompted (Courvoisier, Eid, & Lischetzke, 2012). Compliance with the study protocol was good; around 70% of all signal and interval ratings were completed for both groups, as reported in Table 6.

Table 6. Quality of the EMA data: total signals and compliance

	EMA signals			Missing			Compliance		
	Total N	DE N	Control N	Total N	DE N	Control N	Total %	EDs %	Control %
Subject	7609	3085	4524	0	0	0	100	100	100
Day	7609	3085	4524	0	0	0	100	100	100
Date	7609	3085	4524	0	0	0	100	100	100
Type of signal:	7609	3085	4524	0	0	0	100	100	100
Random signal	2854	1156	1698						
Contingent event	4755	1929	2826						
Type of meal:	4755	1929	2826	1462	547	918	69.2	71.6	67.5
1. Breakfast	377	152	225						
2. Morning snack	271	111	160						
3. Lunch	547	229	318						
4. Afternoon snack	481	169	312						
5. Dinner	665	264	401						
6. Random	949	457	492						
How much:	4755	1929	2826	1462	547	918	69.2	71.6	67.5
1. Too much	540	289	251						
2. Adequate	1554	563	991						
3. Not enough	1196	530	666						
Loss control:	4755	1929	2826	1462	547	918	69.2	71.6	67.5
1. Yes	95	86	9						
2. No	3198	1296	1902						
Hunger	7609	3085	4524	1999	782	1217	73.7	74.7	73.1
Dissatisfied	7609	3085	4524	1998	782	1216	73.7	74.7	73.1
Envious	7609	3085	4524	1995	783	1212	73.8	74.6	73.2
Ashamed	7609	3085	4524	1994	782	1212	73.8	74.7	73.2
Disgusted	7609	3085	4524	1994	782	1212	73.8	74.7	73.2
Angry	7609	3085	4524	1994	782	1212	73.8	74.7	73.2
Lonely	7609	3085	4524	1995	782	1213	73.8	74.7	73.2
Guilty	7609	3085	4524	1994	782	1212	73.8	74.7	73.2
What are you doing:	7609	3085	4524	1867	713	1154	75.5	76.9	74.5
1. Resting	1392	584	808						
2. Socializing	1680	659	1021						
3. Working	2130	886	1244						
4. Exercising	412	205	207						
5. Other	128	38	90						
Where are you:	7609	3085	4524	1867	713	1154	75.5	76.9	74.5
1. Home	1988	836	1152						
2. Car	146	46	100						
3. Restaurant/cafe	1281	504	777						
4. Work/school	1743	719	1024						
5. Outdoor	265	110	155						
6. Other	319	157	162						
Who are you with:	7609	3085	4524	1867	713	1154	75.5	76.9	74.5
1. Alone	1565	706	859						
2. Partner	517	173	344						
3. Friends	893	323	570						
4. Family	254	93	161						
5. Co-workers	2190	915	1275						
6. Others	323	162	161						

Confirmatory analyses

A two-level confirmatory factor analysis with random intercept was performed with EMA data to evaluate the factor structure of the adapted negative affect scale from PANAS-X and Stein (2007) in the EMA protocol.

In the original PANAS-X, four factors measured negative affect: Fear, Hostility, Guilt and Sadness, with a total of twenty-three items. For the purpose of this study, items from the original PANAS-X scales and Stein (2007) protocol have been chosen to measure negative affect (Envious, Ashamed, Guilty, Dissatisfied, Angry, Disgusted and Lonely). The reliability, validity and internal consistency of this reduced model needed to be tested.

The model fit was evaluated using the confirmatory fit index (CFI), the Tucker–Lewis index (TLI) and the root-mean-square error of approximation (RMSEA). To examine whether the model varied over the one-week period, time was included as a covariate.

The CFA indicated that the best-fitting model was a three-factor solution (RMSEA = .024; CFI = .950; TLI = .960) that replicated the results of the original factor analysis. Three original factors have been confirmed in the adapted model: Guilt (Envious, Ashamed, Guilty, Dissatisfied), Hostility (Angry, Disgusted) and Sadness (Lonely; Watson & Clark, 1994). The Cronbach's alphas of these subscales were .82 (Guilt), .83 (Hostility), .84 (Sadness) demonstrating good internal consistency. Model estimates from the CFA demonstrated significant, moderate associations among the three factors, which was expected, given that they represent sub-factors of a global negative affect (NA) scale. Finally, Factor × Time interactions were not significant, indicating that the model structure did not vary over the one-week assessment period.

Hypothesis 1: Convergence of retrospective and ecological momentary measures of DE behaviours.

A moderate convergence in EDE-Q behaviours' frequency and EMA DE behaviours has been hypothesised suggesting that these distinct approaches were concordant for the variables assessed over time. The concordance proposed a moderate consistency in the frequency of DE behaviours over time, meaning that these behaviours have a relative stability and both measures are valid assessments of DE symptoms and frequency of behaviours.

Specifically, the association between EMA behaviour frequency and EDE-Q6 behavioural variables (EDEQ-6: from question 13 to question 18) included: a) EMA frequency of overeating episodes and EDE-Q6 number of times of overeating, b) EMA frequency of loss of control episodes and EDE-Q6 frequency of loss of control episodes, and c) EMA frequency of exercising and EDE-Q6 frequency of exercising.

To note, the timeframe for DE behaviours for the two assessment approaches did not overlap. Specifically, the EDE-Q assessed frequency of behaviour over the previous 28 days, while EMA measured the frequency of behaviours during the one-week EMA protocol, which was subsequent to the 28 days period assessed via EDE-Q6.

Correlation results are presented in Table 7. Across the sample, correlations between the retrospective measure of EDEQ-6 disordered eating behaviour and EMA disordered eating behaviours were moderately large, ranging from .303 to .363 ($p = < .001$). They were significant only for the total sample, but not between diagnostic groups (DE group and controls), as there was a restriction in range when the two groups were analysed separately.

Table 7. Spearman Rho correlations between EMA and retrospective measures of eating disorder behaviours

	EDE-Q6 VS EMA	Spearman rho	P
Eating disordered Behaviour	**Total (N= 136)**		
	Overeating	.363	< .001
	Loss of Control	.303	< .001
	Exercising	.041	.643
	DE sample (N= 55)		
	Overeating	.168	.237
	Loss of Control	-.082	.566
	Exercising	.030	.837
	Control sample (N= 81)	.054	.633
	Overeating	.001	.993
	Loss of control	-.039	.729
	Exercising		

Bland-Altman plots for the significant eating disorder behaviours are presented in Figure 4 (overeating on the left and loss of control on the right). The middle line represents the average discrepancy between EMA and EDE-Q6 across behavioural frequencies, while the lower and upper lines represent the 95% confidence intervals for the average discrepancy. Taken together, the plots suggest overall good agreement between the EMA and the EDE assessment of DE behaviour.

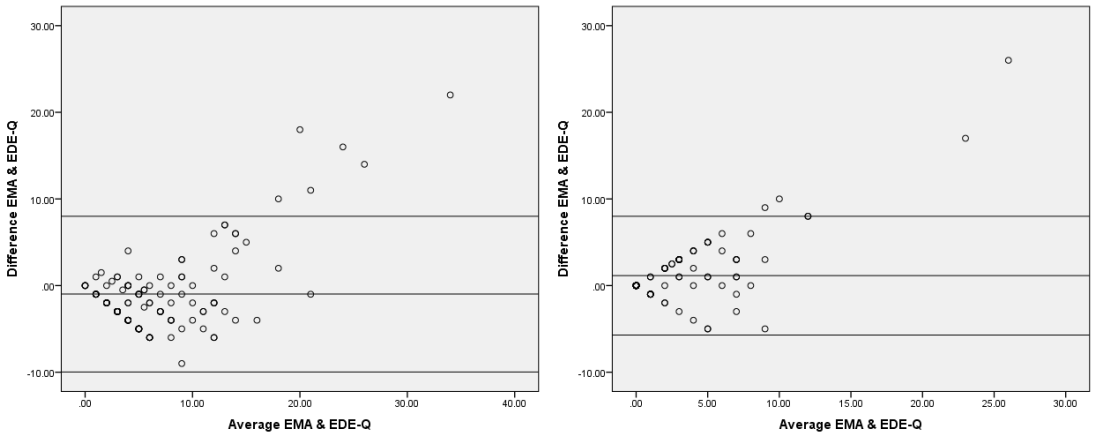

Figure 4. Bland-Altman plots for frequencies of DE behaviours in the total sample.

Hypothesis 2: Difference between eating and non-eating episodes.

In line with the hypothesis that the quantity of food eaten, the type of meal, loss of control, hunger levels and negative affect would be significantly different between DE participants and controls, we expected higher levels of negative affect and more frequent loss of control over eating in DE participants compared to controls. The frequencies of eating episodes, type of meals, quantity eaten and loss of control per day were examined within each group, and the results are reported in Table 8. Due to the non-normality of the data, non-parametrical analyses have been performed.

Table 8. Mean frequencies of eating episodes, type of meal, quantity eaten, loss of control and contextual activities within each group

	Total Frequency	%	DE Frequency	%	Control Frequency	%	Chi	Df	p
Type of signal:							.012	1	.913
Random signal	2189	38.8	898	38.7	1291	38.9			
Contingent event	3454	61.2	1422	61.3	2032	61.1			
Type of meal:							.055	5	**.002**
1. Breakfast	377	11.4	152	11	225	11.8			
2. Morning snack	271	8.2	111	8	160	8.4			
3. Lunch									
4. Afternoon snack	547	16.6	229	16.6	318	16.6			
5. Dinner	481	14.6	169	12.2	312				
6. Random						16.3			
	665	20.2	264	19.1	401	21			
	949	28.8	457	33.1	492	25.7			
How much:							-	2	.272
1 Too much	540	16.4	286	20.8	249	13.1	.019		
2 Adequate	1554	47.2	563	40.7	986	51.9			
3 Not enough	1196	36.3	530	38.4	664	35			
Lose control:							.170	1	**<**
1 Yes	95	2.9	84	6.2	9	0.5			**.001**
2 No	3198	97.1	1296	93.8	1902	99.5			
What are you doing:							.017	4	.192
1. Resting	1392	24.2	584	24.6	808	24			
2. Socializing	1680	29.3	659	27.8	1021	30.3			
3. Working	2139	37.1	886	37.4	1244	36.9			
4. Exercising	412	7.2	205	8.6	207	6.1			
5. Other	128	2.2	38	1.6	90	2.7			
Where are you:							.015	5	.267
1. Home	1988	34.6	836	35.2	1152	34.2			
2. Car	146	2.5	46	1.9	100	3			
3. Restaurant/cafe	1281	22.3	504	21.2	777	23.1			
4. Work/school	1743	30.4	716	30.3	1024	30.4			
5. Outdoor	265	4.6	110	4.6	155	4.6			
6. Other	319	5.6	157	6.6	162	4.8			
Who are you with:							.006	5	.674
1. Alone	1565	27.3	706	29.8	859	25.5			

2.	Partner	517	9	173	7.3	344	10.2
3.	Friends	893	15.6	323	13.6	570	16.9
4.	Family	254	4.4	93	3.9	161	4.8
5.	Co-workers	2190	38.1	915	38.6	1275	37.8
6.	Others	323	5.6	162	6.8	161	4.8

Individuals with DE (N= 55) reported a total of 1,422 eating episodes (a total of 25.85 eating episodes for each participant over the week). They consisted of 563 (40.7%) normal eating episodes (10.2 episodes of normal eating per participant over the week), 530 (38.5%), under-eating episodes (9.6 episodes of under eating per participant over the week) and 286 (20.8%) over-eating (5.2 episodes of overeating per participant over the week). On the other hand, the Control group (N = 81) reported a total of 2,032 eating episodes (a total of 25 eating episodes for each participant over the week), which consisted of 986 (51.9%) normal eating episodes (12.2 episodes of normal eating per participant over the week), 249 (13.1%) of under-eating episodes (3 episodes of under eating per participant over the week) and 664 (35%) of over-eating episodes (7.9 episodes of over eating per participant over the week). The episodes of normal eating, under-eating and overeating lacked of significant difference between DE and control group.

Loss of control was significantly higher in DE participants ($p = < .001$), which recorded a total of 84 (6.15%) episodes of loss of control (a total of 1.5 episodes of loss of control for participant over the week) compared to a total of 9 episodes (0.5%) of loss of control in the control group (a total of 0.11 episodes of loss of control per participant over the week).

The distribution of the type of meal was similar between DE and controls: 225 episodes of breakfast (2.7 per each participant over the week) were recorded by controls compared to 152 episodes of breakfast recorded by DE (2.7 per each participant over the week). 318 lunch episodes were recorded by controls (3.9 lunch

episodes per participant over the week) compared to 229 in DE (4.1 lunch episodes per participant over the week). 312 afternoon snacks were recorded by controls (3.9 afternoon snacks per participant over the week) compared to 169 afternoon snacks in DE (3 episode per participant per week). 401 dinners were recorded by controls (5 dinners per participant per week) compared to 264 in DE (4.8 dinners per participant per week). 492 episodes of random eating were recorded by controls (6 random eating per participant per week) compared to 457 random eating in DE (8.3 random eating per participant per week).

To explore differences in negative affect between the DE group and controls, the two groups were compared on the medians of negative affect variables. Individuals in the DE group reported significantly higher levels of the variables: Envious (Median DE: 67, Median controls: 9, p = < .001), Ashamed (Median DE: 65, Median controls: 7, p < .001), Disgusted (Median DE: 20, Median controls: 12, p = < .001), Lonely (Median DE: 16, Median controls: 6, p = < .001) and Guilty (Median DE: 17.3, Median controls: 10, p = < .001) than the control group, as highlighted in Table 9.

Table 9. Medians, ranges and U test for negative affect variables in DE and Controls

	Total		DE		Control			
	Median	Range	Median	Range	Median	Range	U	P
Dissatisfied	17	1-100	23	1-100	11	1-100	2190	.868
Envious	24	1-100	**67**	1-100	**9**	1-100	499	**<.001**
Ashamed	23	1-100	**65**	1-100	**7**	1-100	703	**<.001**
Disgusted	16	1-100	**20**	1-100	**12**	1-100	1093	**<.001**
Angry	15	1-100	18	1-100	13	1-100	2025	.369
Lonely	11	1-100	**16**	1-100	**6**	1-100	1180	**<.001**
Guilty	13	1-100	**17.3**	1-100	**10**	1-100	891	**<.001**

To sum up, there was a significant difference between DE and controls in the type of meal eaten, loss of control and negative affect levels. Controls had a higher

frequency of meals during the day compared to DE, while DE showed a higher loss of control and higher level of envy, shame, disgust, loneliness and guilt compared to controls.

Hypothesis 3: Negative affect predicts disordered eating.

Hypothesis three investigated which type of negative feelings most predicted DE (EDE-Q6 total scale) and at what extent, controlling for diagnostic group (DE/Control), gender and BMI. The aim was to examine the degree to which each negative affect EMA variable was associated with retrospective measures of DE symptoms (EDE-Q6).

Firstly, the variables were examined for normality. Several variables were found to be positively and negatively skewed. Thus, Spearman bivariate correlations were computed to examine the associations between ecological data and EDEQ-6 retrospective measure and the results are reported in Table 10.

Table 10. Inter-correlations for the variables in the analysis (negative affect variables and EDEQ-6)

	1	2	3	4	5	6	7	8
Dissatisfied	-							
Envious	.266**	-						
Ashamed	.212*	.813**	-					
Disgusted	.259**	.517**	.575**	-				
Angry	.576**	.144	.213*	.324**	-			
Lonely	.365**	.469**	.471**	.590**	.418**	-		
Guilty	.416**	.545**	.560**	.680**	.417**	.794**	-	
EDEQ-6	.024	.606**	.516**	.405**	-.051	.448**	.470**	

**p<.01, *p<.05

Significant correlations were found between EDEQ-6 and negative affect variables; hence, a multiple regression was used for examining at what extent negative affect variables predicted DE (EDE-Q6 total scale), controlling for diagnostic group (DE/Control), gender, and BMI. These particular covariates were selected because they represented variables significantly relevant to DE symptom measures: thus, controlling for these variables provided a stronger test of the unique contribution for the emotion-related variables.

EMA negative affect variables were defined as the average of all momentary ratings participants provided during the EMA protocol. They were the independent variables, while EDEQ-6 served as the dependent variable in the analysis.

The assumption of normality of the residuals was not always met by all the variables, as assessed by Q-Q Plot. A square root transformation was performed to improve normality. The results remained significant prior to and following the transformation of the data. Hence, untransformed data are presented. Diagnostic group (DE/Control), gender, age and BMI were entered at Step 1. At Step 2, all the independent variables (negative affect variables) were entered and the results are reported in Table 11.

Table 11. Multiple Regression Analyses for negative affect variables on EDEQ-6 total scale controlling for diagnostic group, gender and BMI

	B	SE	P	95%IC
1 Diagnostic group	1.99	.129	<.001	1.73-2.25
Gender	-.148	.140	.291	-.426-.129
BMI	-.002	.020	.932	-.041-.038
2 Diagnostic group	1.527	.215	<.001	1.09-1.95
Gender	-.168	.136	.220	-.438-.103
BMI	.002	.020	.930	-.039-.042
Dissatisfaction	.002	.008	.760	-.013-.018
Envious	.017	.009	.083	-.002-.035
Ashamed	-.007	.009	.437	-.026-.011
Disgusted	.004	.008	.651	-.012-.019
Angry	-.016	.010	.134	-.036-.005
Lonely	.027	.010	**.008**	.007-.046
Guilty	-.006	.015	.658	-.036-.023

The full model of gender, age, and BMI variables to predict disordered eating (Step 1) was statistically significant, $R^2 = .754$, F (3, 82) = 83.60, p = < .001; adjusted $R^2 = .745$. The addition of negative affect variables to the prediction of disordered eating (Step 2) led to a statistically significant increase in R^2 of .043, F (7, 75) = 29.43, p = .036. Moreover, feeling of loneliness [B (SE) = .027 (.010), p = .008], significantly predicted the global EDEQ-6 score, controlling for diagnostic group, gender and BMI.

Furthermore, the association between attachment styles (anxious and avoidant), DE measure (EDE-Q6 total score) and the negative affect variables within the EMA protocol, controlling for the covariates of diagnostic group (DE/Control), gender and BMI has been investigated. Hierarchical multiple regressions analysis were chosen as they allowed us to control for the effects of covariates on the results and to take into account the possible causal effects of independent variables (attachment styles and negative affect variables) when predicting a dependent variable (EDEQ-6).

For each analysis, the three covariates were entered at Step 1, anxious attachment scale (Table 12) and avoidant attachment scale (Table 13) at Step 2 and the EMA variables at Step 3 once at a time (Dissatisfied, Envious, Ashamed, Disgusted, Angry, Lonely and Guilty).

Table 12. Hierarchical Linear Regression Analysis for negative affect variables and anxious attachment style, predicting for EDEQ-6 total scale and controlling for diagnostic group, gender and BMI

	B	SE	P	95%IC
1.Diagnostic group	1.99	.129	<.001	1.73-2.25
Gender	-.148	.140	.291	-.426-.129
BMI	-.002	.020	.932	-.041.038
2.Diagnostic group	1.88	.140	<.001	1.6-2.16
Gender	-.160	.138	.413	-.434-.114
BMI	-.008	.020	.520	-.048-.032
Anxiety scale	.116	.063	**.002**	-.009-.241
3.Diagnostic group	1.84	.141	<.001	1.56-2.12
Gender	-.148	.137	.337	-.420-.124
BMI	-.013	.020	.439	-.053-.027
Anxiety scale	.142	.064	**.002**	.014-.270
Dissatisfied	.010	.006	.231	-.003-.023
4.Diagnostic group	1.66	.197	<.001	1.27-2.06
Gender	-.150	.136	.273	-.422-.121
BMI	-.020	.021	.340	-.061-.021
Anxiety scale	.139	.064	**.033**	.012-.267
Dissatisfied	.008	.007	.254	-.006-.021
Envious	.009	.007	.194	-.005-.024
5.Diagnostic group	1.67	.198	<.001	1.28-2.07
Gender	-.143	.137	.302	-.416-.131
BMI	-.018	.021	.387	-.060-.023
Anxiety scale	.140	.064	**.033**	.011-.268
Dissatisfied	.008	.007	.259	-.006-.021
Envious	.013	.010	.166	-.006-.032
Ashamed	-.006	.009	.525	-.023-.021
6.Diagnostic group	1.64	.199	<.001	1.27-2.06
Gender	-.137	.138	.326	-.407-.144
BMI	-.014	.021	.467	-.058-.027
Anxiety scale	.105	.069	.088	-.018-.258
Dissatisfied	.009	.007	.402	-.008-.020
Envious	.014	.010	.151	-.005-.033
Ashamed	-.008	.009	.399	-.027-.011
Disgusted	.005	.007	.439	-.008-.019
7.Diagnostic group	1.64	.202	<.001	1.23-2.04
Gender	-.137	.139	.326	-.414-.139
BMI	-.014	.021	.524	-.056-.029
Anxiety scale	.105	.072	.148	-.038-.248
Dissatisfied	.009	.008	.253	-.007-.025
Envious	.014	.010	.156	-.005-.033
Ashamed	-.007	.009	.451	-.026-.012
Disgusted	.008	.007	.289	-.007-.023
Angry	-.009	.011	.395	-.030-.012

8.Diagnostic group	1.47	.205	<.001	1.06-1.88
Gender	-.177	.135	.192	-.445-.091
BMI	-.004	.021	.867	-.045-.038
Anxiety scale	.068	.070	.336	-.072-.209
Dissatisfied	.004	.008	.653	-.012-.020
Envious	.016	.009	.085	-.002-.035
Ashamed	-.007	.009	.429	-.025-.011
Disgusted	.000	.008	.980	-.015-.016
Angry	-.014	.010	.179	-.035-.007
Lonely	.023	.009	**.010**	.006-.040
9.Diagnostic group	1.49	.219	<.001	1.05-1.92
Gender	-.173	.136	.207	-.445-.098
BMI	-.003	.021	.873	-.045-.039
Anxiety scale	.065	.072	.375	-.079-.209
Dissatisfied	.004	.008	.640	-.012-.020
Envious	.016	.009	.091	-.003-.035
Ashamed	-.007	.009	.493	-.025-.012
Disgusted	.001	.998	.913	-.016-.017
Angry	-.014	.011	.207	-.035-.008
Lonely	.024	.010	**.019**	.004-.045
Guilty	-.004	.015	.796	-.034-.026

The full model of gender, age and BMI variables to predict disordered eating (Step 1) was statistically significant, $R^2 = .754$, F (3, 82) = 83.602, p = < .001; adjusted $R^2 = .745$. The addition of anxiety scale to predict disordered eating (Step 2) led to a significant increase of $R^2 = .010$, F (4, 81) = 65.404, p = .003; adjusted $R^2 = .752$ for the total model. The addition of the negative affect variables to the prediction of disordered eating (Step 3-9) led to an increase in R^2 of .036, F (11, 74) = 26.75, which was significant for the total model (p = < .001). The major contribution was coming from the addition of the Lonely scale, which led to a significant increase of R^2 of .019, F (10, 75) = 29.79, p = .010 (Step 8).

Table 13. Hierarchical Linear Regression Analysis for negative affect variables and avoidant attachment style, predicting for EDEQ-6 total scale and controlling for diagnostic group, gender and BMI

	B	SE	p	95%IC
1. Diagnostic group	1.99	.129	<.001	1.73-2.25
Gender	-.148	.140	.291	-.426-.129
BMI	-.002	.020	.932	-.041-.038
2. Diagnostic group	2	.134	<.001	1.74-2.27
Gender	-.138	.143	.339	-.423-.147
BMI	-.001	.020	.980	-.041-.040
Avoidance	-.027	.078	.728	-.183-.128
3. Diagnostic group	1.99	.135	<.001	1.74-2.26

Gender	-.131	.144	.363	-.417-.155
BMI	-.003	.021	.894	-.044-.038
Avoidance	-.021	.078	.786	-.178-.135
Dissatisfied	.006	.006	.349	-.007-.019
4. Diagnostic group	1.80	.196	<.001	1.41-2.19
Gender	-.133	.143	.354	-.418-.151
BMI	-.010	.021	.631	-.052-.032
Avoidance	-.024	.078	.758	-.180-131
Dissatisfied	.004	.007	.577	-.009-.017
Envious	.010	.007	.182	-.005-.024
5. Diagnostic group	1.81	.197	<.001	1.42-2.20
Gender	-.129	.144	.374	-.415-.158
BMI	-.009	.021	.676	-.052-.034
Avoidance	-.017	.079	.829	-.175-.141
Dissatisfied	.004	.077	.580	-.009-.017
Envious	.014	.010	.172	-.006-.033
Ashamed	-.005	.009	.570	-.024-.013
6. Diagnostic group	1.77	.197	<.001	1.39-2.17
Gender	-.096	.144	.509	-.382-.191
BMI	-.005	.021	.830	-.047-.038
Avoidance	-.053	.082	.521	-.215-.110
Dissatisfied	.001	.007	.866	-.012-.015
Envious	.014	.010	.149	-.005-.034
Ashamed	-.009	.009	.331	-.028-.010
Disgusted	.011	.007	.112	-.003-.024
7. Diagnostic group	1.71	.203	<.001	1.31-2.12
Gender	-.111	.144	.443	-.398-.176
BMI	-.004	.021	.846	-.047-.038
Avoidance	-.040	.082	.626	-.204-.123
Dissatisfied	.007	.008	.427	-.010-.023
Envious	.014	.010	.154	-.005-.034
Ashamed	-.008	.010	.403	-.027-.011
Disgusted	.013	.007	.061	-.001-.027
Angry	-.012	.011	.248	-.033-.009
8. Diagnostic group	1.51	.203	<.001	1.11-1.91
Gender	-.140	.137	.310	-.413-.133
BMI	.007	.021	.732	-.034-.048
Avoidance	-.095	.080	.236	-.255-.064
Dissatisfied	.000	.008	.968	-.016-.016
Envious	.016	.009	.083	-.002-.035
Ashamed	-.007	.009	.422	-.025-.011
Disgusted	.003	.007	.658	-.011-.018
Angry	-.016	.010	.122	-.036-.004
Lonely	.027	.009	**.003**	.010-.044
9. Diagnostic group	1.54	.215	<.001	1.12-1.97
Gender	-.132	.138	.343	-.408-.144
BMI	.007	.021	.741	-.034-.048
Avoidance	-.098	.080	.228	-.258-.062
Dissatisfied	.000	.008	.985	-.016-.016
Envious	.016	.009	.093	-.003-.035
Ashamed	-.006	.009	.488	-.025-.012
Disgusted	.004	.008	.569	-.011-.020
Angry	-.014	.010	.174	-.035-.006
Lonely	.030	.010	**.004**	.010-.049
Guilty	-.008	.015	.608	-.037-.022

The addition of the avoidance scale (Step 2) showed no significant contribution for predicting DE symptoms to the total model, but the addition of EMA-lonely scale contributed a significant increase of R^2 of .025, F (10, 75) = 20.03, p = .003 to the total model (Step 8).

This means that participants with an anxious attachment style showed higher level of DE symptoms, especially when feeling of loneliness were displayed. On the other hand, avoidant attachment style did not significantly contribute to an increase in DE.

Exploratory analysis: Moderating effect of anxious attachment style on the negative affect variable "lonely" and disordered eating

In accordance with the previous analyses, Loneliness was the only variable that contributed to DE when an anxious attachment was displayed. Therefore, we were interested in investigating if anxious attachment style might act as moderator in the relationship between DE symptomatology (EDEQ-6 total scale) and the level of loneliness (EMA loneliness scale).

A hierarchical multiple regression with moderation term was run to assess the statistical significance of the interaction term between Lonely and Anxious Attachment Scale. The variables under investigation were mean-centred prior to the analyses. Linearity was established by visual inspection of a scatterplot and there was no evidence of multicollinearity. There was homoscedasticity, as assessed by visual inspection of the studentized residuals plotted against the predicted values for DE participants and controls. The studentized residuals were not always normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). EDEQ-6 total scale, Anxious Attachment Scale and Loneliness variables were found to be extremely and

moderately skewed, respectively, and, hence, have been transformed using LG10 and SQRT function.

A hierarchical linear regression with moderation term was performed: normalised-centered Anxious Attachment Scale had been entered at STEP 1, followed by normalised-centered Loneliness scale at STEP 2 and finally the interaction term at STEP 3. The results are reported in Table 14.

Table 14. Moderating effect of anxious attachment style on negative affect variable "Lonely" and EDEQ-6

	B (SE)	Beta	t	p	ΔR^2
STEP1					
Loneliness	.392 (.138)	.467	2.84	.008	.218
STEP 2					
Loneliness	.354 (.140)	.423	2.53	.017	
Anxiety	.171 (.138)	.206	1.23	<.001	**.040**
STEP 3					
Loneliness	1.2 (.391)	1.440	3.08	.005	
Anxiety	1.07 (.411)	1.293	2.61	.015	
Loneliness X Anxiety	-1.62 (.701)	-1.679	-2.31	**.029**	.123
Lonely X Anxiety X DE	.016 (.022)	.109	.746	**.126**	
Lonely X Anxiety X control	-.016(.022)	-.083	-.746	**.256**	.002

Results showed that there was a significant moderating effect of the Anxious Attachment Scale, as evidenced by the addition of the interaction term explaining an additional 12.3% of the total variance, p = .029. Simple slopes analysis revealed that there was not a statistically significant positive linear relationship between disordered eating and the interaction between anxious attachment style and feeling of loneliness in DE participants (p = .126) and controls (p = .259). Results are represented in Figure 5.

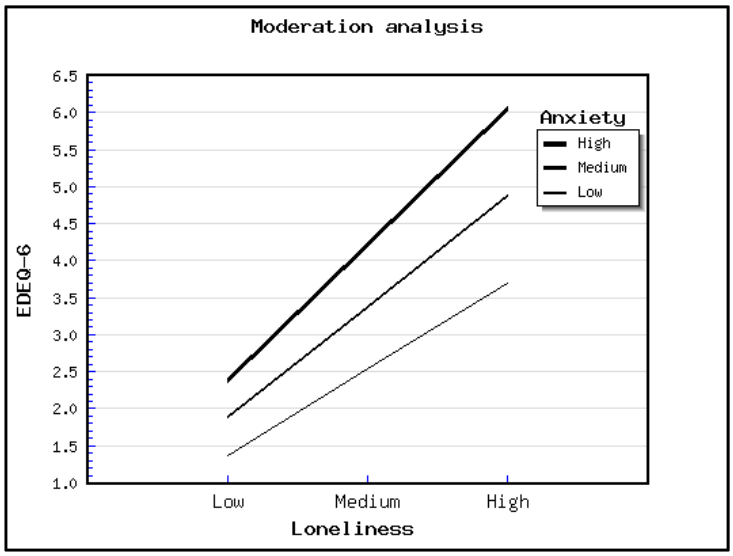

Figure 5. Moderation analysis between EDEQ-6 and the level of loneliness when anxiety acts as moderator

As the figure shows, Anxious Attachment Style might act as a moderator between the level of loneliness and DE symptomatology. Three levels of Anxious Attachment Style and Loneliness have been displayed: high, medium and low. Higher levels of Loneliness were related to a more Anxious Attachment Style, which corresponded to an increased level of DE symptomatology (see the right side of Figure 2).

Hypothesis 4: Ecological momentary assessment of antecedents in DE

Hypothesis 4 stated that DE participants were more likely to display higher levels of negative affect (i.e., guilt) at the time of eating and after that compared to controls and they will be more prone to eat in certain situations (i.e., being at home alone). A within-subject design was adopted to address our aims to assess whether antecedent situations of eating varied between the eating disordered group and controls.

Firstly, due to the presence of repeated categorical, correlated and clustered responses, a within-subject design was adopted to address whether antecedent conditions varied in DE participants and in controls. The individual observations were

the unit of analyses: the self-initiated participant EMA entries and non-eating alarm entries were analysed.

To account for the nesting of multiple categorical observations within subjects, data were analysed using logistic generalised estimating equations (GEE) with a binary logit link function and autoregressive correlation. This analysis considered each EMA entry occasion (eating vs non-eating) as a categorical dependent variable modelled as a function of the situational variable (e.g., affect and situation).

The Kolmogorov-Smirnov statistics and histograms for each group indicated that a violation of normality was present ($p < .05$). A square root transformation of the variables was performed to improve normality. The results of GEE using the variables remained significant prior to, and following, the transformation of the data; so, untransformed data are presented. To offset issues of collinearity and to preserve power, separate models were run for each independent variable. The robust covariance estimator was used to correct for underestimation of standard errors, thus reducing type 1 error. Mean, standard deviation, frequencies, odds ratio and confidence intervals (95%) are reported in Table 15 for DE and 16 for controls.

Table 15. Antecedents of eating and non-eating episodes in the DE group (55 participants)

	Eating Occasion Mean(SD)	Non eating Occasion Mean(SD)	Odds ratio: Eating vs non eating (95% IC)	p
Hungry	26.72 (22.70)	25.32 (22.47)	.999 (.997-1.001)	.139
Dissatisfied	34.20 (30.11)	32.90 (29.15)	1.000 (.998-1.002)	.259
Envious	57.11 (29.47)	57.28 (28.69)	1.001 (.999-1.003)	.823
Ashamed	57.66 (29.78)	53.64 (30.67)	.997 (.996-.999)	.172
Disgusted	29.90 (26.71)	25.57 (24.40)	.998 (.996-1.000)	**.001**
Angry	26.22 (26.26)	24.54 (23.63)	1.000 (.998-1.002)	.472
Lonely	22.52 (23.52)	21.05 (22.71)	1.001 (.998-1.003)	.435
Guilty	25.20 (24.00)	18.77 (18.36)	.992 (.989-.995)	**<.001**
Situational Context				
Resting	27.5	20.0	1.270 (.823-1.960)	.279
Socialising	25.5	28.8	1.145 (1.007-1.302)	**.039**
Working	40.6	32.8	1.063 (.941-1.200)	.328
Exercising	1.4	20.3	5.870 (4.468-7.712)	**<.001**
Other	2.1	1.0	.787 (.510-1.215)	.279
Home	37.6	31.5	.847 (.753-.952)	**.005**
Car	2.4	1.2	.737 (.517-1.051)	.092
Restaurant/Café'	21.9	19.4	1.034 (.894-1.197)	.653
Work/School	32.6	26.5	.975 (.861-1.104)	.694
Outdoor	3.4	6.5	1.661 (1.272-2.168)	**<.001**
Others	1.5	14.9	4.338 (3.360-5.601)	**<.001**
By myself	31.7	27.5	.883 (.786-.993)	**.037**
With partner	7.2	7.0	1.076 (.854-1.356)	.534
With friends	13.6	12.7	1.050 (.878-1.255)	.595
With family	3.6	4.5	1.245 (.964-1.606)	.093
With co-workers	42.1	33.2	.943 (.833-1.068)	.357
With others	1.8	15.1	3.990 (3.125-5.094)	**<.001**

Table 16. Antecedents of eating and non-eating episodes in the control group (81 participants)

	Eating Occasion M(SD)	Non eating Occasion M (SD)	Odds ratio: Eating vs non eating (95% IC)	P
Hungry	24.11 (19.13)	22.55 (20.36)	.996 (.992-.999)	**.020**
Dissatisfied	20.14 (24.67)	21.26 (24.79)	1.001 (.999-1.003)	.234
Envious	17.74 (22.64)	17.87 (22.89)	.999 (.997-1.001)	.493
Ashamed	17.02 (22.52)	18.37 (24.00)	1.002 (1.000-1.004)	.110
Disgusted	18.76 (21.81)	20.04 (22.08)	1.002 (1.000-1.004)	.102
Angry	19.52 (22.52)	19.43 (21.87)	.999 (.998-1.001)	.309
Lonely	13.40 (18.15)	13.42 (18.15)	.999 (.997-1.001)	.499
Guilty	14.12 (16.40)	14.39 (16.83)	1.000 (.997-1.003)	.966
Situational Context				
Resting	25.2	22.5	.831 (.457-1.512)	.544
Socialising	31.3	28.4	.809 (.412-1.588)	.538
Working	38.9	33.6	.834 (.460-1.513)	.550
Exercising	2.0	12.6	5.467 (2.655-11.257)	**<.001**
Other	2.6	2.9	1.203 (.661-2.190)	.544
Home	35.7	32.6	.522 (.312-.872)	.070
Car	2.7	2.9	.578 (.317-1.054)	.074

Restaurant/Café'	24.3	21.0	.482 (.286-.811)	**.006**
Work/School	32.0	27.8	.469 (.273-.808)	**.006**
Outdoor	3.6	6.2	.742 (.429-1.284)	.287
Others	1.8	9.6	1.915 (1.146-3.200)	**.003**
By myself	26.5	24.0	.603 (.359-1.013)	.056
With partner	10.1	10.1	.649 (.376-1.121)	.121
With friends	16.8	17.3	.646 (.392-1.064)	.086
With family	5.1	4.2	.603 (.350-1.041)	.069
With co-workers	39.7	34.8	.665 (.388-1.140)	**.040**
With others	1.8	9.5	1.659 (.988-2.787)	.055

Results indicated that DE participants were more likely to eat when feelings of disgust (OR = .998 [.996 - 1.000]) and guilt (OR = .992 [.989 -.995]) were elevated compared to non-eating episodes. On the other hand, the control sample showed that (OR = .996 [.992-.999]) was higher during an eating episode compared to a non-eating episode.

Regarding situational antecedents, the DE group was more likely to eat at home (OR = .847 [.753-.952]) and when they were alone (OR = .883 [.786-.993]). They reported a statistical significant reduction of eating when they were engaging in physical (OR = 5.870 [4.468-7.712]) and social (OR = 1.145 [1.007-1.302]) activities or when they were outdoor (OR = 1.661 [1.272-2.168]) and among strangers (OR = 3.990 [3.125-5.094]). On the other hand, the control group reported significantly more eating episodes at restaurants/pubs/cafes (OR = .482 [.286-.811]), at work/school (OR = 469 [.273-.808]) and with co-workers or students (OR = .665 [.388-1.140]) compared to a significant reduction of eating episodes when exercising (OR = 5.467 [2.655-11.257]).

Secondly, a repeated measure MANOVA and paired-sample t-tests were performed to test if in the DE sample there was a significant difference in the level of negative affect at the time of eating and after that. MANOVA was used because it takes into account the inter-correlations among the dependent variables and protects against inflated Type 1 error caused by conducting multiple repeated measure t-tests.

All assumptions of linearity, homogeneity of variance-covariance matrices, and the absence of multicollinearity were met, and there were no univariate or multivariate outliers. The studentized residuals have been tested for normality and the Kolmogorov-Smirnov statistics and histograms for each group indicated that a violation of normality was present ($p < .05$). Positively and negatively skewed variables have been transformed to improve normality. The results of MANOVA using the variables remained significant prior to, and following, the transformation of the data; so, untransformed data are presented in Table 17.

Table 17. Comparison between eating and post-eating ratings in DE (n=55)

	Eating M (SD)	Post-eating M (SD)	T	p
Hungry	24.72 (19.02)	25.06 (23.27)	-2.309	.084
Dissatisfied	51.73 (29.32)	31.20 (29.21)	6.047	**.007**
Envious	60.11 (26.76)	56.60 (29.89)	4.067	.766
Ashamed	46.98 (29.77)	49.49 (29.40)	-3.052	.193
Disgusted	28.57 (24.49)	30.13 (27.07)	-4.387	.113
Angry	31.97 (28.04)	25.23 (25.83)	2.601	.051
Lonely	34.11 (30.02)	30.53 (21.61)	5.680	.733
Guilty	27.76 (24.77)	24.76 (23.85)	-1.463	**.003**

Eating and post-eating rating were compared across DE participants to assess the antecedences of eating. A repeated-measures MANOVA indicated a statistically significant difference in eating and post scores (Wilks' $\lambda = .132$, $p = < .001$) in feelings of dissatisfaction ($p = .007$) and guilt ($p = .003$).

Hypothesis 5a: Longitudinal changes in negative affects and hunger level one-hour prior to and after eating episodes in DE and controls

Mixed effects models were used to evaluate the longitudinal changes in antecedents and consequences one-hour prior to and after eating in the DE group and

controls. These models include fixed effects to test for relationships between variables of interest and random effects to estimate variation attributable to sampling error (Singer & Willett, 2003). This analysis takes into consideration the dependency of EMA data arising from repeated measurement.

Negative affect variables were the dependent variables. Separate analyses for each negative affect variables were conducted to distinguish the facet of negative affect. Time before and after eating episodes was the independent variable in the analyses, with pre and post eating period restricted to one-hour. Eating episodes were located in time using data participants provided, dummy coding the time passed before and after eating episodes (i.e., "0" as eating episode, "-1" as one hour before eating episode and "1" as one hour after eating episode). Finally, the variable "diagnostic group" (DE/Controls) was the dichotomous variable entered as factor as well.

Negative affect variables were centered on their respective grand mean prior to the analysis. Centering on the grand mean allowed for a comparison of individuals prior to and after eating, making it a person-level comparison. Models included a random intercept (allowing individuals to vary about their own average level of negative affect) and fixed effects to assess the relationship between time (one-hour before and after eating episode), diagnostic group and negative affect, including all two-way interactions (time x diagnostic group; time x eating episodes; diagnostic group x eating episodes).

A prerequisite of mixed model analyses is the normality of the residuals. The variables: Hunger level, Dissatisfied and Disgusted, showed that normality was met, as assessed by the Shapiro-Wilk test and Kolmogorov-Sminov test of normality and there were no outliers, as assessed by no studentized residuals greater than ± 3

standard deviations. On the other hand, the analysis of studentized residuals of the variables Envious, Ashamed, Lonely and Guilty did not follow the normal distribution. Hence, they have been transformed and the subsequent analysis of the transformed studentized residuals showed there was normality. There were no outliers in the data, as assessed by inspection of a boxplot. There was homogeneity of variances as assessed by Levene's test for equality of variances.

A Bonferroni adjustment for multiple comparisons was applied and estimates in the models were evaluated with statistical significance set at p of .025 [because of the two-way interaction the current level of statistical significance at ($p < .05$) is divided by the number of two-way interactions (2); Wallenstein et al., 1980]. Separate models were run for each independent variable and the results are summarised in Table 18.

Table 18. Mixed model of dependent variables by time (one-hour before/after eating), diagnostic group (DE/Controls) and their interactions

	Estimate	SE	t (381)	p	IC
Hungry					
Intercept	-.263	1.80	-.147	1.000	-7.29, 6.77
1 hour before	.068	.154	.442	.658	-.233, .370
1 hour after	.179	.115	1.555	.120	-.046, .406
Diagnosis (DE/Controls)	.237	.140	1.682	.093	-.039, .513
Diagnosis x -1 hour	-.140	.239	-.587	.557	-.609, .328
Diagnosis x +1 hour	.006	.181	.004	.997	-.354, .355
Dissatisfied					
Intercept	1.02	.135	7.57	**<.001**	-12.1, 11.14
1 hour before	-.244	.227	-1.072	.284	-.513, .238
1 hour after	-.043	.173	-.251	.801	-.450, .114
Diagnosis (DE/Controls)	-1.50	.175	-8.595	**<.001**	1.16, 1.85
Diagnosis x -1 hour	.107	.297	.359	.719	-.690, .476
Diagnosis x +1 hour	-.124	.225	-.552	.581	-.317, .566
Envious					
Intercept	2.49	.177	-14.04	**<.001**	-1.75, -1.34
1 hour before	-.278	.214	-.1.29	.194	-.491, .215
1 hour after	-.016	.163	-.100	.920	-.248, .238
Diagnosis (DE/Controls)	-4.03	.165	-24.4	**<.001**	3.71, 4.36
Diagnosis x -1 hour	.140	.280	.502	.616	-.690, .409
Diagnosis x +1 hour	.033	.212	.159	.874	-.449, .382
Ashamed					
Intercept	2.28	.132	17.27	**<.001**	-3.76, .845
1 hour before	-.483	.222	-2.17	.030	-.709, .025
1 hour after	.224	.169	1.325	.185	-.345, .206
Diagnosis (DE/Controls)	3.74	.171	21.823	**<.001**	3.40, 4.08
Diagnosis x -1 hour	.141	.291	-.487	.626	-.712, .428

Diagnosis x +1 hour	-.294	.220	-1.336	.182	-.137, .726
Disgusted					
Intercept	-.203	1.99	-.102	.919	-4.11, 3.71
1 hour before	-.428	.177	-2.412	**.016**	-.777, -.080
1 hour after	-.237	.133	-1.778	.075	-.499, .024
Diagnosis (DE/Controls)	.643	.162	3.951	**<.001**	.324, .962
Diagnosis x -1 hour	.290	.276	1.052	.293	-.251, .832
Diagnosis x +1 hour	.639	.208	3.062	**.002**	.230, 1.04
Angry					
Intercept	.456	.124	3.657	**<.001**	-5.98, 5.51
1 hour before	-.026	.210	-.126	.900	-.616, .076
1 hour after	.028	.159	.176	.860	-.328, .191
Diagnosis (DE/Controls)	-.689	.161	-4.262	**<.001**	.372, 1.00
Diagnosis x -1 hour	-.243	.274	-.885	.376	-.295, .781
Diagnosis x +1 hour	-.096	.207	-.466	.641	-.310, .504
Lonely					
Intercept	-.456	1.04	-.435	.664	-1.14, .228
1 hour before	-.067	.170	-.396	.692	-.402, .267
1 hour after	.030	.128	.234	.815	-.221, .281
Diagnosis (DE/Controls)	1.01	.156	6.488	**<.001**	.708, 1.32
Diagnosis x -1 hour	.067	.265	.255	.799	-.452, .587
Diagnosis x +1 hour	.163	.200	.813	.416	-.230, .556
Guilty					
Intercept	.237	1.12	-.211	**<.001**	-8.81, 7.93
1 hour before	-.028	.191	-148	.882	-.477, .153
1 hour after	.642	.145	.4.412	**<.001**	-.234, .239
Diagnosis (DE/Controls)	-.675	.147	-4.585	**<.001**	.386, .964
Diagnosis x -1 hour	-.133	.250	-.533	.594	-.356, .623
Diagnosis x +1 hour	.639	.189	-3.380	**.001**	.268, 1.01

The model examined the effect of the time one-hour before and after eating on negative affect variables. For example, at the time of eating the estimated mean of the variable "Dissatisfied" was 1.02 (SE = .135), p = < .001; before and after eating the level of dissatisfaction decreased by an estimated mean of -.244 (SE = .227) and -.043 (SE = .173) respectively. This means that there was a rise in the level of dissatisfaction during eating, compared to the hour before.

The estimated mean of the variable "Envious" was 2.46 (SE = .177) at the time of eating. When comparing the level of envy before and after eating, it decreased by an estimated mean of -.278 (SE = .241) one hour before eating and by an estimated mean of -.016 (SE = .163) one hour after eating. The level of envy rose during the eating behaviour compared to the hour before and after.

The estimated mean of the variable “Ashamed” was 2.28 (SE = .132), p = < .001 at the time of eating, while it decreased by an estimated mean of -.483 (SE = .222) one hour before eating and it increased by .224 (SE = .169) one hour after eating. This means that the level of shame was rising with time.

The estimated mean of the variable “Disgusted” was not significant at the time of eating (estimate= -.203, SE = 1.99, p = .919), but it showed a decrease before and after eating, which was significant one hour before eating (estimate = -.428, SE = .177, p = .016).

The estimated mean of the variable “ Angry” was .456 (SE = .124), p = < .001 at the time of eating. It showed a decrease one hour before eating (estimate = -.026, SE = .210) and an increase one hour after eating (estimate = .028, SE = .159), meaning that the level of anger was rising with time.

The estimated mean of the variable “Lonely” was not significant at the time of eating (estimate = -.456, SE = 1.04, p = .664); it showed a decrease before eating (estimate = -.067, SE = .170) and an increase that (estimate = .030, SE = .128).

Finally, the estimated mean level of the variable “Guilty” was .237 (SE = 1.12) at the time of eating; it showed a decrement of an estimated mean of -.028 (SE = .191) one hour before eating and an increment of an estimate of .642 (SE= .145) one hour after eating. This means that there was a rise in the level of guilt with time.

The effects of diagnostic group (DE/Controls), time (one hour prior to and one hour after eating), eating behaviours and their interactions were entered simultaneously. A significant association between negative affect variables and diagnostic group (DE/controls) has been found for all the variables (except for the variable “Hungry”). This indicated that the inclusion of diagnostic group had a significant effect on the level of negative affect variables.

For example, the inclusion of the diagnostic group in the variable "Dissatisfied", "Envious", "Angry" and "Guilty" caused a drop of an estimated mean of -1.50 (SE = .173), -4.03 (SE = .165), -.689 (SE = .161) and -.675 (SE = .147), respectively. Bonferroni post hoc analysis revealed that the decrease of the estimate mean caused by the inclusion of the diagnostic group was significant for the variables Dissatisfied p = < .001, Envious p < .001, Angry p < .001 and Guilty p < .001. This means that the inclusion of the diagnostic group lowered the level of these variables.

On the other hand, the inclusion of the diagnostic group in the variable "Ashamed", "Disgusted" and "Lonely" caused a rise of an estimate of 3.74 (SE = .171), .643 (SE = .162) and 1.01 (SE = .156), respectively. Bonferroni post hoc analysis revealed that the increase of the estimate mean caused by the inclusion of the diagnostic group was significant for the variables Ashamed p = < .001, Disgust p < .001 and Lonely p < .001. This means that the inclusion of the diagnostic group caused a rise in the level of these variables.

Moreover, the interaction between diagnostic group and time before and after eating highly affected the level of negative affect. The inclusion of the diagnostic group in the variable "Dissatisfied" caused a rise of an estimated mean of .107 (SE = .297) one hour before eating and a drop of an estimated mean of -.124 (SE = .225) one hour after eating, with a different trend between the two groups. In the DE group, the level of the variable "Dissatisfied" showed an increase with time (one hour before eating estimated marginal mean = 4.8, SE = .181; time of eating estimated marginal mean = 5.00, SE = .109; one hour after eating estimated marginal mean = 5.05, SE = .131).

On the other hand, in the Control group, the level of "Dissatisfied" did not vary much (one hour before eating estimated marginal mean = 3.4, SE = .157; time of

eating estimated marginal mean = 3.37, SE = .091; one hour after eating estimated marginal mean = 3.54, SE = .112), as shown in the Figure 6.

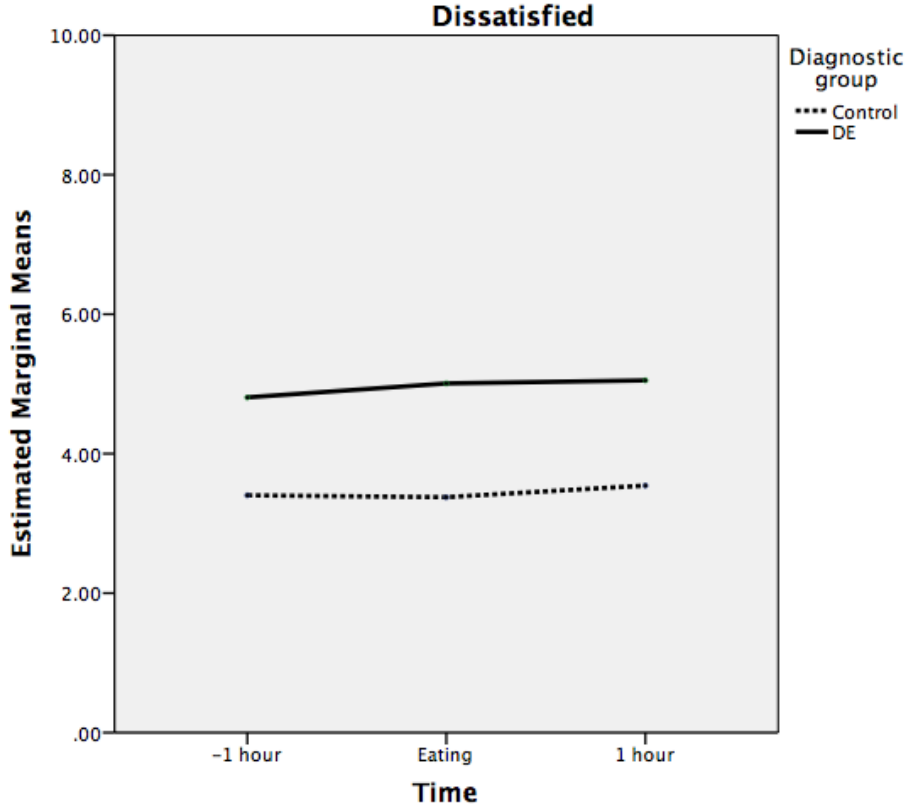

Figure 6. Level of dissatisfaction by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, the level of the variable "Dissatisfied" did not vary much with time in both groups, but it was higher in DE than in controls.

The inclusion of the diagnostic group in the variable "Envious" caused a rise of an estimated mean of .140 (SE = .280) and .033 (SE = .212) before and after meal respectively, with a different trend between the two groups. In the DE group, the level of "Envious" increased with time from an estimated marginal mean of 6.86 (SE = .170) one hour before eating, to an estimated marginal mean of 7.12 (SE = .094) at the time of eating and to an estimated marginal mean of 7.14 (SE = .115) one hour after eating. In the Control group, the level of "Envious" rose from an estimated marginal mean 2.94 (SE = .153) one hour before eating to an estimated marginal mean of 3.11

(SE = .089) at the time of eating and to an estimated marginal mean of 3.10 (SE = .110) 1 hour after eating, as Figure 7 shows.

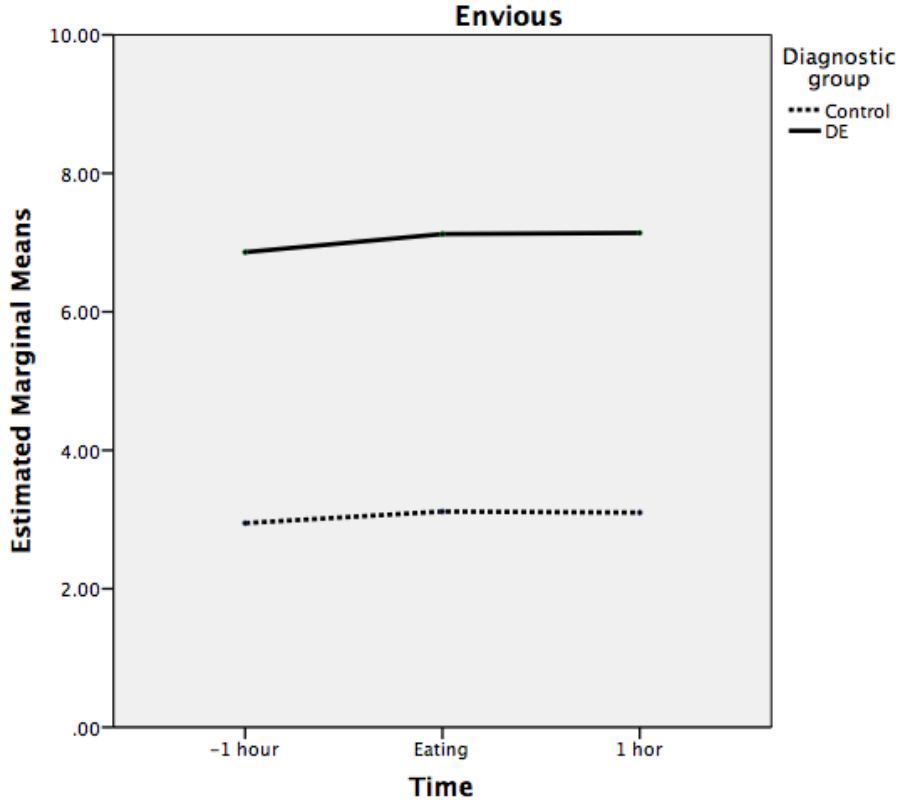

Figure 7. Level of envy by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, the level of the variable "Envious" rose slightly with time in both groups and in the DE group was definitely higher than in controls.

The inclusion of the diagnostic group in the variable "Ashamed" caused a rise of an estimated mean of .141 (SE = .291) and a decrease of an estimated mean of -.294 (SE = .220) after meals, with a different trend between the two groups. In the DE group, the level of the variable "Ashamed" increased from an estimated marginal mean of 6.35 (SE = .190) one hour before eating to an estimated marginal mean of 7.06 (SE = .098) at the time of eating and it decreased to an estimated marginal mean of 6.83 (SE = .128) one hour after eating. In the Control group, the level of the variable "Ashamed" rose from an estimated marginal mean of 2.76 (SE = .156) one

hour before eating to an estimated marginal mean of 3.02 (SE = .091) at the time of eating to an estimated marginal mean of 3.09 (SE = .112) one hour after eating, as Figure 8 shows.

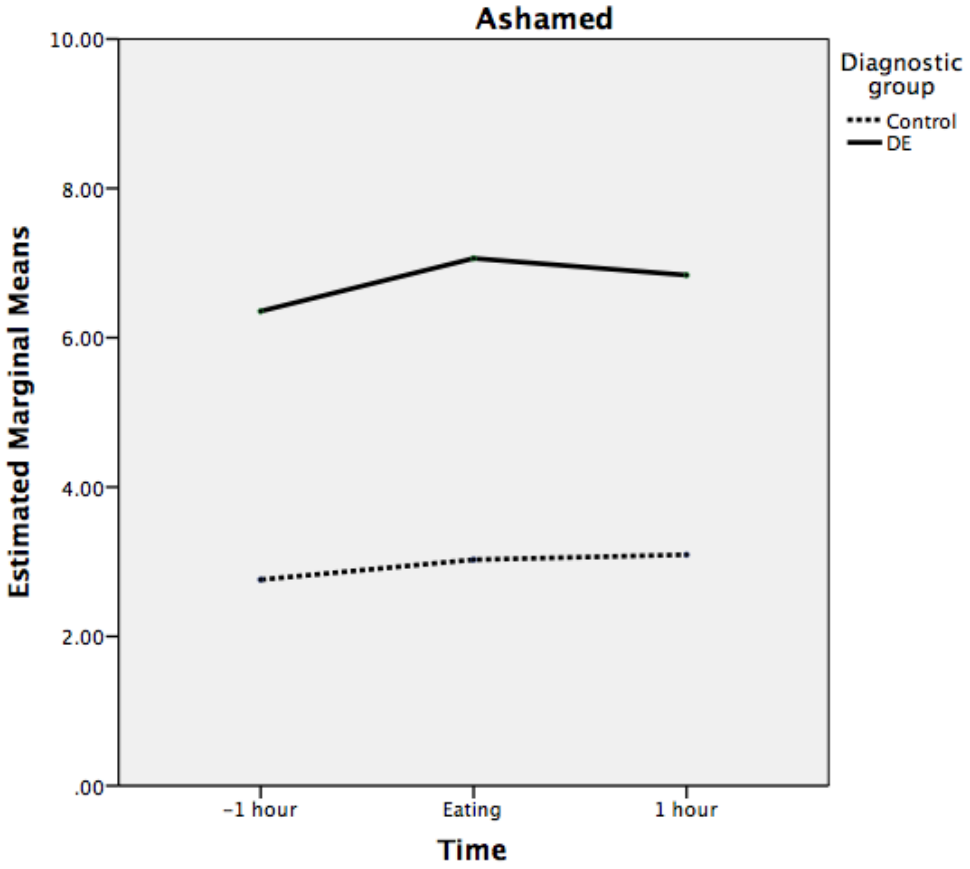

Figure 8. Level of shame by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, DE participants had a higher level of shame compared to controls, which rose slightly at the time of eating and it dropped after that. On the other hand, in controls the level of the variable "Ashamed" rose slightly with time.

The inclusion of the diagnostic group in the variable "Disgusted" caused a rise of an estimated mean of .290 (SE = .276) and .639 (SE = .208) before and after meal respectively, with a different trend between the two groups. In the DE group the level of the variable "Disgusted" increased from an estimated marginal mean of 4.13 (SE = .169) one hour after eating to an estimated marginal mean of 4.67 (SE = .101) at the

time of eating and it decreased to an estimated marginal mean of 4.27 (SE = .122) one hour after eating. In the Control group, the level of the variable "Disgusted" rose from an estimated marginal mean of 3.2 (SE = .145) one hour before eating to an estimated marginal mean of 3.39 (SE = .084) at the time of eating and to an estimated marginal mean of 3.48 (SE = .104) one hour after eating.

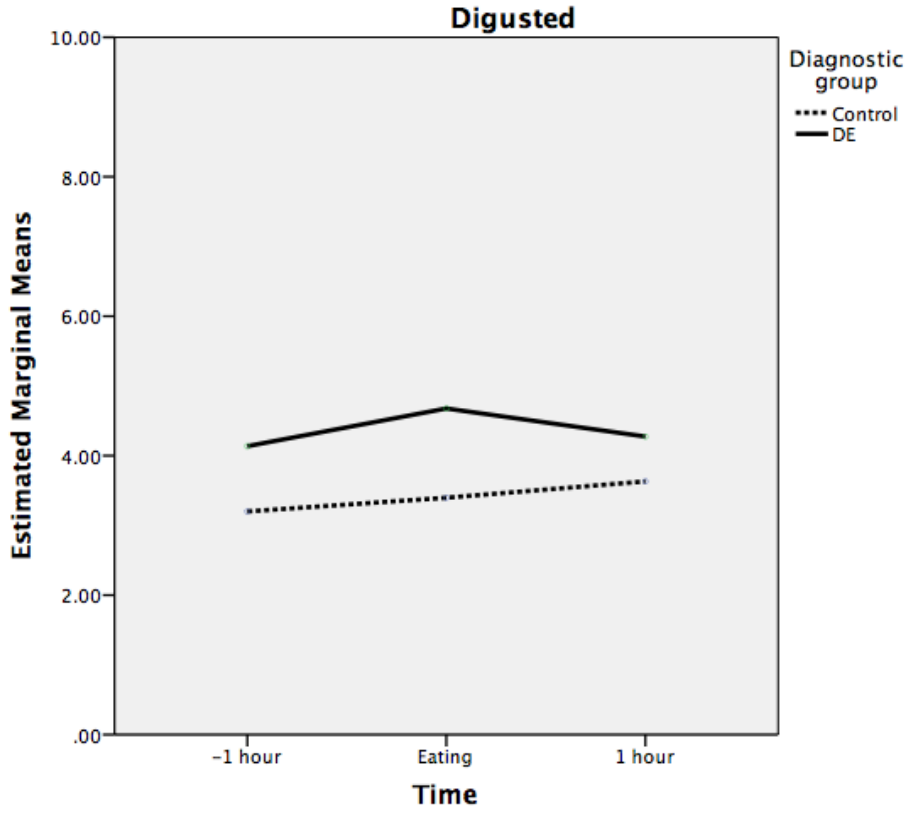

Figure 9. Level of disgust by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, in DE participants the level of the variable "Disgusted" rose slightly at the time of eating and it dropped after that. On the other hand, controls showed an increase in the level of disgust with time.

The inclusion of the diagnostic group in the variable "Angry" caused a decrease of the variable level of an estimated mean of -.243 (SE = .274) and -.096 (SE = .207) before and after meals, respectively, with a different trend between the two groups. In the DE group the level of the variable "Angry" rose from an estimated

marginal mean of 4.15 (SE = .150) one hour after eating to an estimated marginal mean of 4.20 (SE = .100) at the time of eating and it slightly decreased to an estimated marginal mean of 4.17 (SE = .122) one hour after eating. In the control group, the level of the variable rose from an estimated marginal mean of 2.52 (SE = .135) one hour before eating to an estimated marginal mean of 2.62 (SE = .079) at the time of eating and it decreased slightly to an estimate marginal mean of 2.59 (SE = .097) one hour after eating.

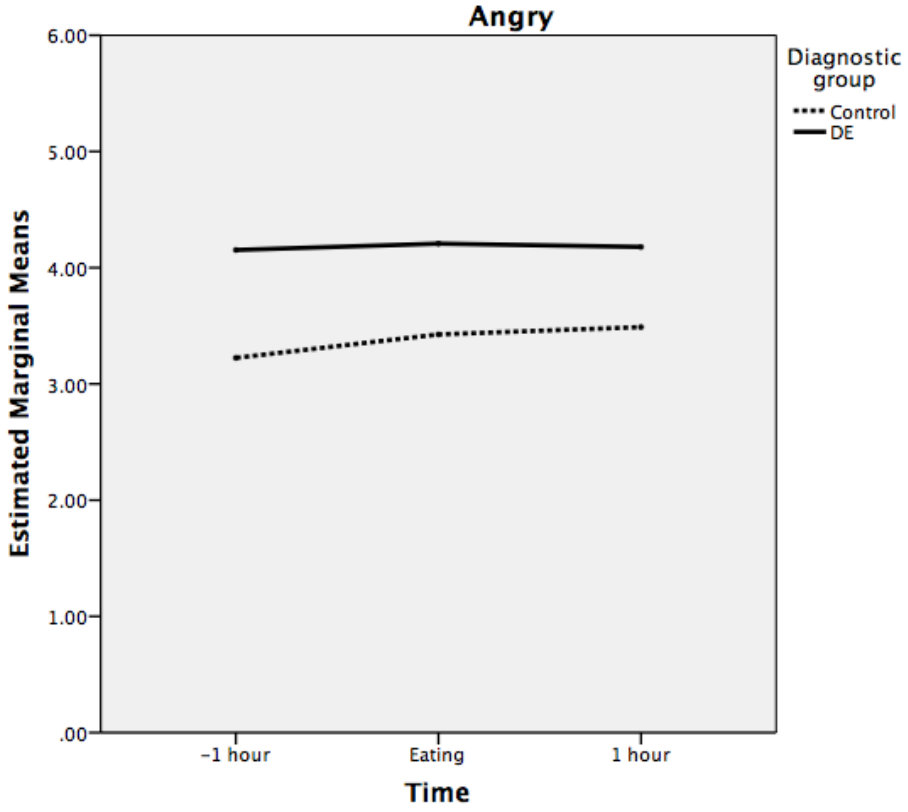

Figure 10. Level of anger by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, the level of the variable "Angry" was higher in the DE group than in controls. In the DE group the level of anger did not vary much with time, while in controls it showed a slight rise with time.

The inclusion of the diagnostic group in the variable "Lonely" caused a rise of the variable level from an estimated mean of .067 (SE = .265) before meals to an

estimate of .163 (SE = .200) after meals, respectively, with a different trend between the two groups. In the DE group the level of the variable "Lonely" increased from an estimated marginal mean of 3.60 (SE = .167) one hour before eating to an estimated marginal mean of 3.80 (SE = .099) at the time of eating and it decreased to an estimated marginal mean of 3.60 (SE = .126) one hour after eating. In the Control group, the level of the variable rose from an estimated marginal mean 2.69 (SE = .129) one hour before eating to an estimated marginal mean of 2.86 (SE = .075) at the time of eating and it decreased to an estimated marginal mean of 2.85 (SE = .092) one hour after eating.

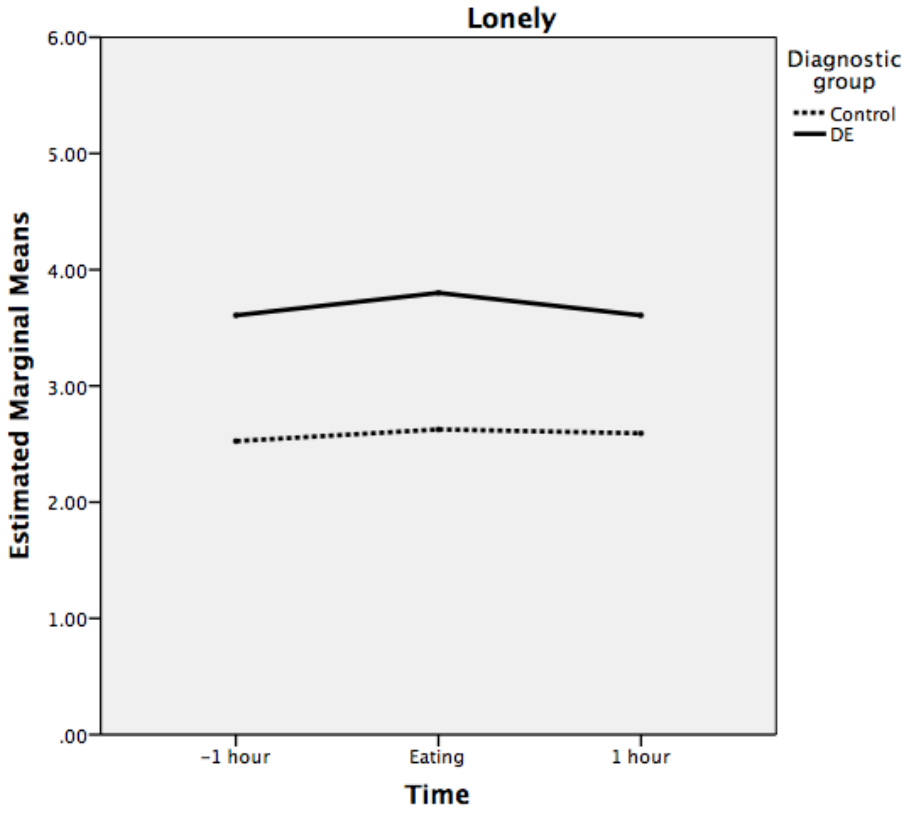

Figure 11. Level of loneliness by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, the DE group had a slight increase in the level of loneliness at the time of eating and it decreased after that. In the control group, the level of "Lonely" did not vary much with time.

The inclusion of the diagnostic group in the variable "Guilty" caused a decrease of the variable level of an estimated mean of -.133 (SE = .250) before meals and a rise of an estimate of .639 (SE = .189) after meals, with a different trend between the two groups. In the DE group, the level of the variable "Guilty" rose from an estimated marginal mean of 3.50 (SE = .151) one hour before eating to an estimated marginal mean of 4.17 (SE = .097) at the time of eating and it decreased to an estimated marginal mean of 3.53 (SE = .110) one hour after eating. In the control group, the level of the variable rose from an estimated marginal mean of 13.58 (SE = .866) before eating to an estimated marginal mean of 14.53 (SE = .504) at the time of eating and it decreased slightly to an estimated marginal mean of 14.34 (SE = .623) one hour after eating.

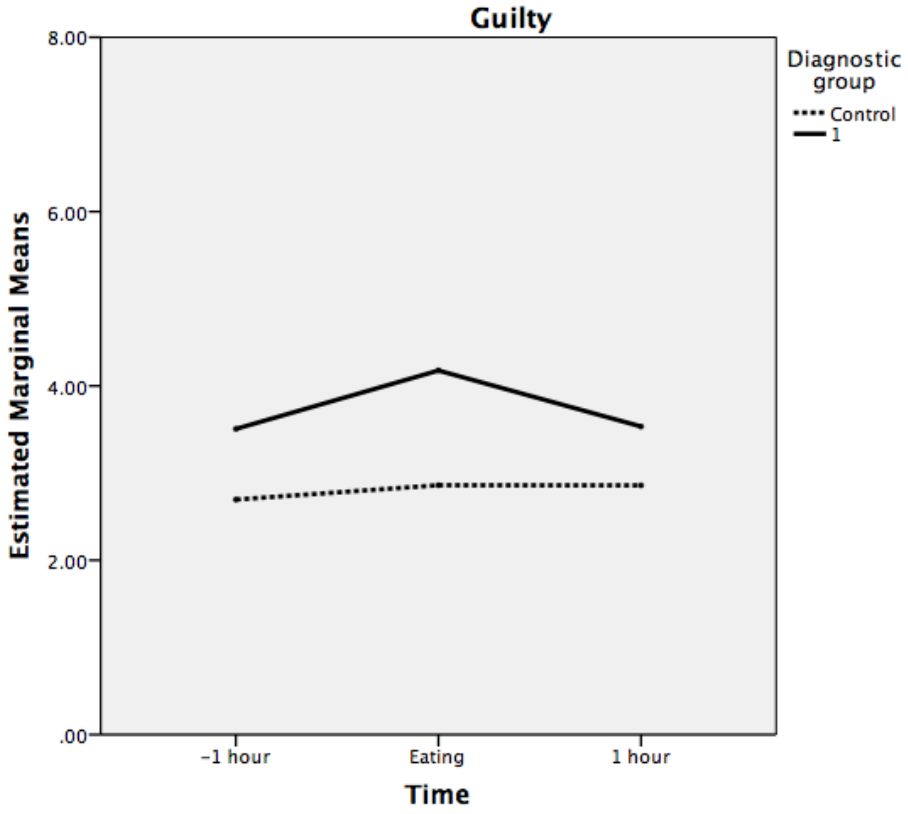

Figure 12. Level of guilt by group (DE/Controls) and time (1-hour before and after eating)

As the figure shows, the level of guilt rose before eating and dropped after that in the DE group. On the other hand, in the controls the level of the variable "Guilty" did not vary much; it rose slightly with time.

Hypothesis 5b: Longitudinal changes in negative affect and hunger levels in DE and controls over the 7-day period

We hypothesised that there would be a significant difference between DE participants and controls in the level of negative affect and hunger over the period under observation. In particular, it was anticipated that DE participants would be more likely to display higher levels of negative affect and hunger than controls, with different trends depending on the specific variable.

A repeated measure ANOVA (with Greenhouse correction) using a mixed linear model tested the longitudinal changes in hunger levels and negative affect variables to determine if scores varied significantly over time and between groups (DE group/controls). To assess for the interaction and main effect of group and time, ANOVA with repeated measure involved the analysis of the main effect and interactions between two groups (DE/controls) X time (seven days) in a mixed within-between design. This approach allowed for direct comparison between groups across time (Oberfeld & Franke, 2013). Diagnostic group (DE/Control) was the between-subject variable with two levels and time was a within-subject variable with 7 levels (Day 1, Day 2, Day 3, Day 4, Day 5, Day 6, Day 7 and Day 8). The model used restricted maximum likelihood estimates and a compound symmetry error structure because of the repeated measure of the data.

Core assumptions in the repeated measure ANOVA procedure require sphericity and normality of the studentized residuals. Hence, an analysis of the

studentized residual and Greenhouse-Geisser correction for sphericity was performed (Weisberg, 2014). For the variables: Hunger level and Disgusted, the analysis of the studentized residuals showed that there was normality, as assessed by the Shapiro-Wilk test and Kolmogorov-Sminov test of normality and no outliers, as assessed by no studentized residuals greater than ± 3 standard deviations. On the other hand, the analysis of studentized residuals of the variables Dissatisfied, Envious, Ashamed, Lonely and Guilty did not follow the normal distribution. Hence, they have been transformed and the subsequent analysis of the transformed studentized residuals showed there was normality.

We proceeded analysing the transformed data. A Bonferroni adjustment for multiple comparisons was applied and estimates in the models were evaluated with statistical significance set at p of .025 [because of the two-way interaction the current level of statistical significance at ($p < .05$) is divided by the number of two-way interactions (2); Wallenstein et al., 1980]. The results are reported in Table 19.

Table 19. Repeated Measures Analyses of Variance for each variable under investigation

	SS	Df	MS	F	p
Hungry					
Between-group					
Diagnosis	84.73	1	84.73	27.85	**<.001**
Within-group					
Time	32.21	3.32	9.68	3.67	**.010**
Time X Diagnosis	152.8	3.32	45.9	17.42	**<.001**
Dissatisfied					
Between-group					
Diagnosis	450.7	1	450.7	43.2	**<.001**
Within-group					
Time	4.67	4.54	1.02	.299	.899
Time X Diagnosis	2.25	4.54	.497	.144	.976
Envious					
Between-group					
Diagnosis	1627	1	1627	149.8	**<.001**
Within-group					

Time	18.2	4.26	2.69	.099	.067
Time X Diagnosis	16.19	4.26	4.96	1.61	.689
Ashamed					
Between-group					
Diagnosis	1820	1	1820	152.4	**<.001**
Within-group					
Time	332.5	4.46	74.43	21.42	**<.001**
Time X Diagnosis	179.5	4.46	38.19	10.99	**<.001**
Disgusted					
Between-group					
Diagnosis	231.5	1	231.5	30.56	**<.001**
Within-group					
Time	52.59	5.22	10.07	4.89	.112
Time X Diagnosis	21.75	5.22	4.16	1.94	.082
Angry					
Between-group					
Diagnosis	87.7	1	87.7	11.68	**.001**
Within-group					
Time	21.52	4.9	4.33	1.77	.117
Time X Diagnosis	30	4.9	6.04	2.47	.032
Lonely					
Between-group					
Diagnosis	223	1	223	27.97	**<.001**
Within-group					
Time	25.82	4.6	5.54	1.64	.150
Time X Diagnosis	14.46	4.6	3.1	.924	.460
Guilty					
Between-group					
Diagnosis	350	1	350	59.59	**<.001**
Within-group					
Time	277	4.6	60.1	24.07	**<.001**
Time X Diagnosis	36.9	4.6	8	3.2	**.009**

A mixed model repeated measures ANOVA with a Greenhouse-Geisser correction determined that there was a significant change in negative affect variables and hunger across the period under observation (seven days). In addition, the effects of diagnostic group (DE/Controls), time (seven days), and their interactions on the level of negative affect variables and hunger were entered simultaneously in a mixed

model design. A significant between-group effect was found for all the variables under observation, meaning that the diagnostic group had a significant effect on the level of the variables [Between-group Hunger: F (1, 131) = 27.85, p = < .001; Dissatisfied: F (1, 131) = 43.2, p = < .001; Envious: F (1, 131) = 149.8, p = < .001; Ashamed: F (1, 131) = 154.4, p = < .001; Disgusted: F (1, 131) = 30.56, p = < .001; Angry: F (1, 131) = 11.68, p = < .001; Lonely: F (1, 131) = 27.97, p = < .001; Guilty: F (1, 131) = 59.59, p = < .001].

On the other hand, a significant within-group effect of time was found only for the variables: Hunger, Ashamed and Guilty. This means that time played a significant role in the level of these variables over the seven-day period. Moreover, a significant between-within group interaction has been found for the variables: Hunger, Ashamed, Angry and Guilty. This means that the interaction between time and diagnostic group played a significant role in increasing and decreasing the level of these variables.

In particular, significant results have been found for the variable "Hunger", which showed a significant between- and within-group effect. There was a statistically significant interaction between time and diagnostic group, F (3.3, 359) = 17.42, p = < .001. The main effect of time showed a statistically significant difference in estimated mean of "Hunger" at different time points, F (3.3, 359) = 3.67, p = .010. The main effect of diagnostic group showed that there was a statistically significant difference in estimated mean of "Hunger" between groups, F (1, 131) = 27.85, p = < .001. In particularly, in the DE group, the level of "Hunger" rose slightly from an estimated mean of 4.76 (SE = .149) at Day 1 to 5.17 (SE = .150) at Day 2 and it decreased to 5.09 (SE = .161) at Day 3, to 4.97 (SE = .136) at Day 4 and to 4.88 (SE = .146) at Day 5. It increased slightly to 5.01 (SE = .137) at Day 6 and to 6.65 (SE = .299) at Day 7. On the other hand, in the control group the level of hunger did not

vary much between days, going from an estimated mean of 4.66 (SE = .123) at Day 1 to 4.77 (SE = .112) at Day 4 and it gradually decreased to 4.05 (SE = .247) at Day 7, as Figure 13 shows.

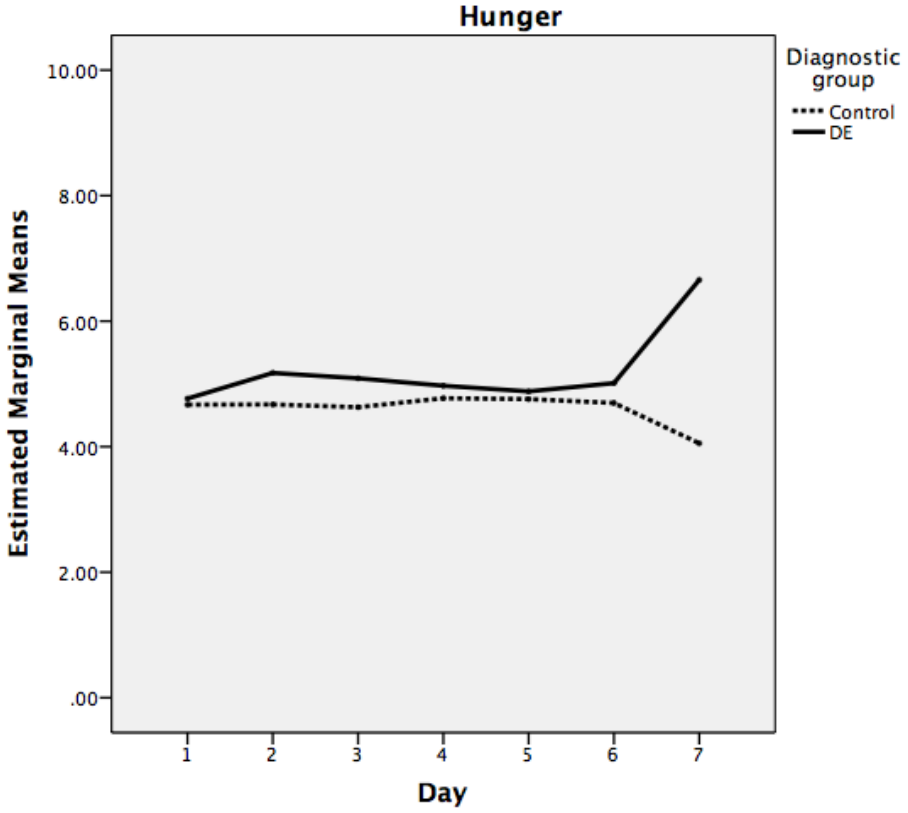

Figure 13. Longitudinal changes in the level of hunger between groups over the 7-days period

The plot shows a slightly higher level of hunger in DE participants than controls until Day 6. After that, the level of hunger suddenly increased in the DE group, while it decreased in the control group.

Significant results have been found for the variable "Ashamed", which showed a significant between- and within-group effect. There was a statistically significant interaction between time and diagnostic group, F (4.4, 585) = 10.99, p = < .001. The main effect of time showed a statistically significant difference in estimated mean of "Ashamed" at different time points, F (4.4, 585) = 21.42, p = < .001. The main effect of diagnostic group showed that there was a statistically significant difference in estimated mean of "Ashamed" between groups F (1, 131) = 152.4, p = <

.001. In particularly, in the DE group, the level of "Ashamed" gradually decreased from an estimated mean of 7.12 (SE = .228) at Day 1 to 4.17 (SE = .261) at Day 7. On the other hand, in the control group the level of shame did not vary much between days. It gradually rose from an estimated mean of 3.42 (SE = .188) at Day 1 to 4.15 (SE = .269) at Day 5 and it decreased to 3.19 (SE = .216) at Day 7, as Figure 14 shows.

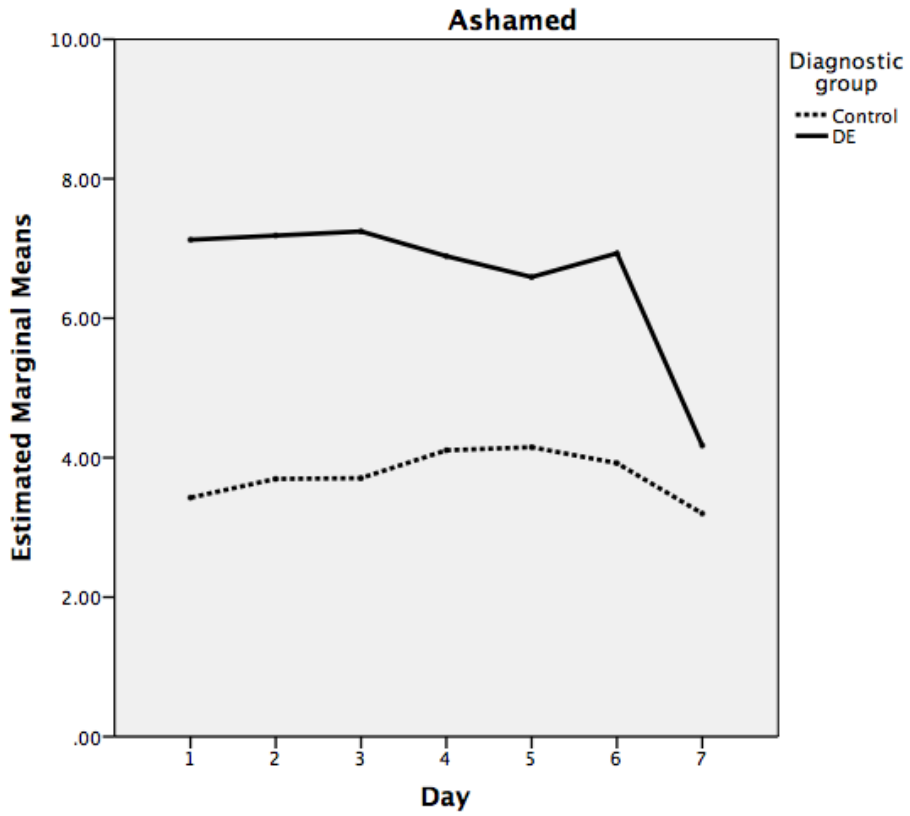

Figure 14. Longitudinal changes in the level of shame between groups over the 7-days period

The plot shows a higher level of shame in DE participants with a sudden drop at Day 6. On the other hand, controls showed a more consistent level of shame across the seven-day period, which was lower than in the DE group.

Significant results have been found for the variable "Guilty", which showed a significant between- and within-group effect. There was a statistically significant interaction between time and diagnostic group, F (4.6, 605) = 3.2, p = .009. The main

effect of time showed a statistically significant difference in the estimated mean of "Guilty" at different time points, F (4.6, 605) = 24.07, p = < .001. The main effect of diagnostic group showed that there was a statistically significant difference in the estimated mean of "Guilty" between groups F (1, 131) = 59.59, p = < .001. In particularly, in the DE group, the level of guilt dropped from an estimated mean of 4.7 (SE = .198) at Day 1 to 4.42 (SE = .200) at Day 2. It rose to an estimate of 4.6 (SE = .188) at Day 4 and it dropped to 4.37 (SE = .187) at Day 5. Finally, it increased to an estimated mean of 6.62 (SE = .298) at Day 7. The control group showed a similar trend: the level of guilt gradually rose from an estimated mean of 3.1 (SE = .164) at Day 1 to 3.5 (SE = .155) at Day 5. It dropped to an estimate of 3.3 (SE = .170) at Day 6 and it suddenly rose to an estimated mean of 4.5 (SE = .247) at Day 7, as Figure 15 shows.

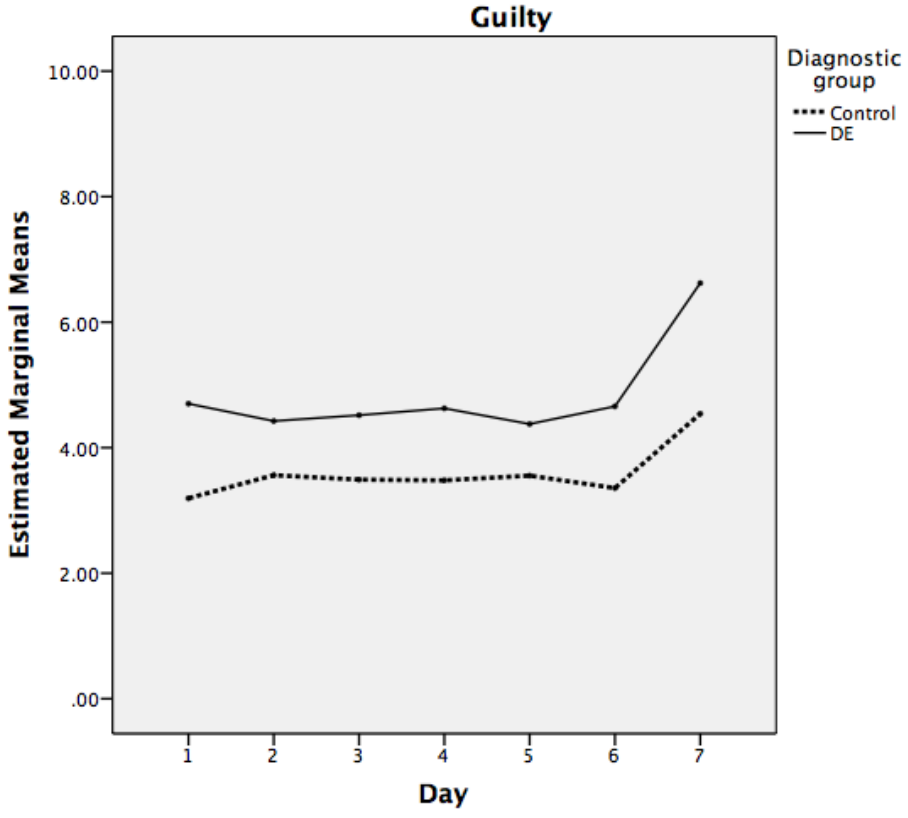

Figure 15. Longitudinal changes in the level of guilt between groups over the 7-day period

The plot shows a higher level of guilt in DE compared to controls with a similar trend between the two groups, with a sudden increase of the level of guilt at Day 7 in both groups.

Significant results have been found for the variable "Angry", which showed a significant between-group effect and a significant between-and within-group interaction. There was an interaction between time and diagnostic group, $F(4.9, 650) = 2.4$, $p = .032$. The main effect of time did not show a statistically significant difference in estimated mean of "Angry" at different time points, $F(4.9, 650) = 1.77$, $p = .117$. The main effect of diagnostic group showed that there was a statistically significant difference in estimated mean of "Angry" between groups $F(1, 131) = 11.68$, $p = < .001$. In particularly, in the DE group, the level of anger did not vary much over the seven-day period, dropping from an estimated mean of 4.9 (SE = .237) at Day 1 to an estimate of 4.4 (SE = .242) at Day 3. It rose from an estimated mean of 4.9 (SE = .242) at Day 4 and it dropped to an estimate of 4.7 (SE = .157) at Day 7. On the other hand, in the control group the level of anger gradually increased from an estimated mean of 3.8 (SE = .196) at Day 1 to an estimate of 4.13 (SE = .200) at Day 4. It gradually dropped to an estimate of 3.96 (SE = .201) at Day 6 and it suddenly rose to an estimated mean of 4.8 (SE = .130) at Day 7, as Figure 16 shows.

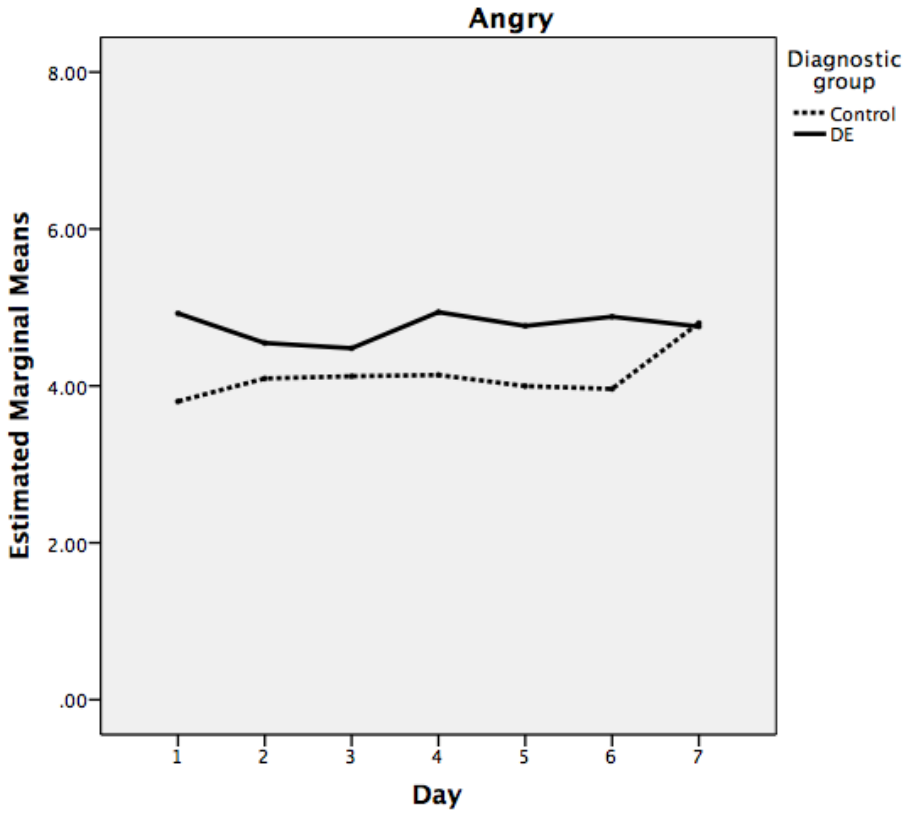

Figure 16. Longitudinal changes in the level of anger between groups over the 7-day period

The plot shows a higher level of anger in DE participants than controls with a similar trend between the two groups. Controls showed a sudden increase in the level of anger at Day 7 reaching the level displayed by the DE group.

Study 2

Characteristics of the sample and hypothesis 1

The sample (N = 90) consisted of 42 females with DE and 48 female healthy controls. DE participants were significantly more likely to smoke (N DE = 15, 35.7%; N controls = 8, 16.7%; p = .039), suffer from Polycystic Ovarian Syndrome (PCOS; N DE = 4, 9.5%; N controls = 0, 0%, p = .029) and depression (N DE =10, 23.8%; N controls = 2, 4.2%; p = .006). Moreover, DE subjects were significantly more likely to have someone in their family who had ovarian cancer (N DE = 9, 21.4%; N controls = 1, 2.1; p = .004) and eating disorders (N DE = 7, 16.7%; N controls = 0, 0%, p = .003).

Hypothesis 1 stated that DE sufferers would be more likely to experience menstrual irregularities and dysfunctions (e.g., PCOS) compared to controls. The result showed that DE subjects were significantly more likely to suffer from PCOS compared to controls, but the majority of them did not report having menstrual irregularities. Table 20 displays frequencies of baseline characteristics for each group.

Table 20. Medical history baseline measures: frequencies and percentages

	DE (n=42)	%	Controls (n=48)	%	$\chi 2$ (1)	P
Regular period					.989	.320
Yes	38	90.5	40	83.3		
No	4	9.5	8	16.7		
Smoke					4.272	**.039**
Yes	15	35.7	8	16.7		
No	27	64.3	40	83.3		
Alcohol					2.009	.156
Yes	22	52.4	18	37.5		
No	20	47.6	30	62.5		
Anxiety disorders					3.420	.064
Yes	8	19	3	6.3		
No	34	81	45	93.8		
Diabetes					.020	.888
Yes	4	9.5	5	10.4		
No	38	90.5	45	89.6		
PCOS				`	4.784	**.029**
Yes	4	9.5	0	0		
No	38	90.5	48	100		

Endometriosis					-	-
Yes	0	0	0	0		
No	42	100	48	100		
Infertility					1.350	.245
Yes	3	7.1	1	2.1		
No	39	92.9	47	97.9		
Depression					7.479	**.006**
Yes	10	23.8	2	4.2		
No	32	76.2	46	95.8		
High Blood pressure					1.033	.309
Yes	4	9.5	2	4.2		
No	38	90.5	46	95.8		
Thyroid problem					.029	.865
Yes	3	7.1	3	6.3		
No	39	92.9	45	95.8		
Cancer					1.156	.282
Yes	1	2.4	0	0		
No	41	97.6	48	100		
Past eating disorder					14.212	**<.001**
diagnosis	13	31	1	2.1		
Yes	29	69	47	97.9		
No						
Osteoporosis					2.338	.126
Yes	2	4.8	0	0		
No	40	95.2	48	100		
Irritable bowel					1.033	.309
syndrome	4	9.5	2	4.2		
Yes	38	90.5	46	95.8		
No						
High cholesterol					2.363	.124
Yes	4	9.5	1	2.1		
No	38	90.5	47	97.9		
Kidney problem					-	-
Yes	0	0	0	0		
No	42	100	48	100		
Other					10.035	.002
Yes	8	19	0	0		
No	34	81	48	100		
Family diabetes					.170	.680
Yes	14	33.3	18	37.5		
No	28	66.7	30	62.5		
Family cardiovascular					.268	.605
diseases	18	42.9	18	37.5		
Yes	24	57.1	30	62.5		
No						
Family breast cancer					.321	.571
Yes	8	19	7	14.6		
No	34	81	41	85.4		
Family ovarian cancer					8.488	**.004**
Yes	9	21.4	1	2.1		
No	33	78.6	47	97.9		
Family endometriosis					1.350	.245
Yes	3	7.1	1	2.1		
No	39	92.9	47	97.9		
Family PCOS					2.338	.126
Yes	2	4.8	0	0		
No	40	95.2	48	100		
Family					1.033	.309
depression/anxiety	4	9.5	2	4.2		
Yes	38	90.5	46	95.8		

No						
Family eating disorder					8.675	**.003**
Yes	7	16.7	0	0		
No	35	83.3	48	100		

Quality of the EMA data

Daily assessments were nested within each participant (N= 90). Over the two-weeks period, of the 1350 "end of the day" signals, 693 signals were answered by participants, while 650 were skipped or ignored. These recordings included 587 (84.6%) non-menstrual events and 107 (15.4%) menstrual events. DE subjects completed 280 (40.4%) signals, while controls 413 (59.6%). In particular, DE subjects recorded 235 (33.9%) non-menstrual events and 45 (6.5%) menstrual events. On the other hand, controls recorded 351 (50.6) non-menstrual events and 62 (8.9%) menstrual events. Participants' compliance rates were calculated by dividing the number of completed entries by the total number of the "end of the day" signals, resulting in an average compliance rate of 52%.

Hypothesis 2: Menstrual symptoms' differences in DE and controls

The hypothesis two stated that DE participants would be more likely to experience symptoms typically associated with menstruation (such as cravings, bloating, breast sensitivity/tension, headache, fatigue and feeling of anxiety/sadness) more acutely and more discomfortingly than healthy controls. Hence, it was expected that the level of the variables ("experience of cravings", "sensation of bloating", "physical pain", "level of anxiety", "sadness", "anger", "fatigue", "mood swings", "breast sensitivity/tension" and "headache") would be higher in DE participants than in the control group.

The data were not normally distributed, as assessed by boxplot and Shapiro-Wilk test ($p > .05$). After attempts to transform the skewed variables, the residuals resulted were still not normal; hence, we proceeded with the non-parametrical analyses. A one-way ANOVA on ranks test was conducted to determine if there were significant differences in scores between the 4 groups: the non-menstruating control group (CNM), menstruating control group (CM), non-menstruating DE group (DENM) and menstruating DE group (DEM). Median, range, one-way ANOVA on ranks, post analyses for each variable across groups are reported in table 21.

Table 21. One-way ANOVA on ranks with post hoc analysis

	Menstruating day				Non-menstruating day						
	DE (N=19)		Control (N=18)		DE (N=23)		Control (N=30)		$X^2(3)$	P	Post hoc Bonferroni
	Med	Range	Med	Range	Med	Range	Med	Range			
Cravings	23	1-89	30	0-86	25	1-85	35	0-98	1.76	.415	
Bloating	18	1-98	3	0-85	12	2-93	10	0-100	25.06	**<.001**	DEM>CM<DENM >CNM(p=.020)
Physical pain	25	1-78	23	0-70	48	0-78	3	0-79	6.85	**.032**	DEM<CM<DENM >CNM(p=.011)
Anxiety	10	0-94	26	0-95	11	0-98	4	0-100	5.29	.071	
Sadness	12	0-100	11	0-100	17	0-100	11	0-100	19.4	**<.001**	DEM>CM<DENM >CNM(p=.009)
Anger	40	0-60	39	2-57	37	0-60	34	0-60	1.12	.570	
Fatigue	58	0-100	68	0-71	62	0-86	56	0-100	5.43	.066	
Mood swings	45	1-60	45	0-60	43 .2	0-51	38	1-60	.749	.688	
Breast sensitivity	13	0-96	5	0-88	19	0-100	11	0-100	16.36	**<.001**	DEM>CM<DENM >CM(p<.001)
Headache	25	1-95	46	0-84	33	0-100	21	0-100	.304	.859	

Note: DEM= menstruating DE; CM= menstruating Controls; DENM= non--menstruating DE; CNM= non-menstruating Controls

Distributions of scores were statistically significantly different between the groups for the variables: "bloating" [$\chi2$ (3) = 25.06, p = < .001], "physical pain" [$\chi2$ (3) = 6.85, p = .032], "sadness" [$\chi2$ (3) = 19.4, p = < .001] and "breast sensitivity/tension" [$\chi2$ (3) = 16.36, p = < .001]. Pairwise comparisons were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. The post hoc analysis revealed statistically significant differences in

scores between the four groups for the variables: “bloating” ($p = .020$), “physical pain” ($p = .011$), “sadness” ($p = .015$) and “breast sensitivity/tension” ($p = < .001$). As hypothesised, DE participants reported greater bloating during their period compared to non-menstrual days and controls. On the other hand, they reported greater feeling of sadness, physical pain and breast sensitivity/tension during non-menstrual days compared to menstrual days and compared to controls.

Moreover, an investigation of the effect that menstrual cycle might have on DE participants and controls has been performed over the 15-day period. A three-way mixed design analysis of variance (ANOVA) with time as repeated measure tested for changes in the variables under examination across the two-week period.

The variables under examination were: “Craving”, “Bloating”, “Physical Pain”, “Anxiety”, “Sadness”, “Anger”, “Fatigue”, “Mood Swings”, “Breast Sensitivity/tension” and “Headache” as the dependent variables. Menstrual status and groups were between-subject factors with two levels (menstruating/ non-menstruating and DE/controls). Time was the within-subject factors with 15 levels, corresponding to the two-week period under observation.

Residual analysis was performed to test for the assumptions of the three-way mixed design ANOVA. Outliers were assessed by inspection of a boxplot, normality was assessed using Shapiro-Wilk’s normality test for each cell of the design and homogeneity of variances was assessed by Levene's test. All the variables showed the presence of outliers, which have been removed from the analysis. Residuals did not meet the assumption of normality. The skewed variables have been transformed and the three-way mixed design ANOVA with time as a repeated measure has been run on the transformed data. Every dependant variable has been tested for homogeneity of variance, as assessed by Levene’s test for equality of variances. Bonferroni

adjustment for multiple comparisons has been applied and the statistical significance of a two-way interaction and a simple main effect was accepted at a Bonferroni-adjusted alpha level of .025. The three-way interaction has been interpreted as whether the two-way between-subjects interaction of diagnosis*menstruation is different at the different levels of time. The results are reported in table 22.

Table 22. Three-way mixed design ANOVA with time as repeated measure

	SS	Df	MS	F	P
Cravings					
Between subjects					
Diagnosis	271	1	271	2.81	.100
Menstruation	28.7	1	28.7	.298	.558
Diagnosis X menstruation	171.86	1	171.86	1.78	.188
Within subject					
Time	1899	5	15332	135.68	**<.001**
Time X diagnosis	22.89	5	1144	4.52	.854
Time X menstruation	208.5	5	405.8	41.25	**.004**
Time X diagnosis X menstruation	84.85	5	268.3	16.78	.202
Bloating					
Between subjects					
Diagnosis	.096	1	.096	.001	.972
Menstruation	40.64	1	40.64	.543	.465
Diagnosis X menstruation	.095	1	.095	.011	.972
Within subject					
Time	235.7	8.8	26.8	3.39	**<.001**
Time X diagnosis	80.4	8.8	9.14	1.15	.322
Time X menstruation	50.4	8.8	5.73	.725	.687
Time X diagnosis X menstruation	109.1	8.8	12.4	1.57	.124
Physical pain					
Between subjects					
Diagnosis	408.9	1	408.9	5.38	.037
Menstruation	22.54	1	22.54	.297	.595
Diagnosis X menstruation	8.24	1	8.24	.109	.747
Within subject					
Time	34.14	3.67	9.29	.469	.743
Time X diagnosis	23.16	3.67	6.3	.318	.850
Time X menstruation	69.91	3.67	19.03	.960	.433
Time X diagnosis X menstruation	92.32	3.67	25.13	1.26	.296
Anxiety					
Between subjects					
Diagnosis	13.54	1	13.54	.186	.669
Menstruation	115.8	1	115.8	1.58	.214
Diagnosis X menstruation	91.82	1	91.82	1.25	.268
Within subject					
Time	212.8	9.09	24.4	2.47	**.002**
Time X diagnosis	64.19	9.09	7.05	.745	.669
Time X menstruation	63.68	9.09	7	.739	.675
Time X diagnosis X menstruation	87.95	9.09	9.67	1.02	.423
Sadness					
Between subjects					
Diagnosis	36.18	1	.442	.442	.510
Menstruation	392.7	1	4.79	4.79	.034
Diagnosis X menstruation	46.34	1	.566	.556	.456
Within subject					
Time	146.1	7.8	10.43	1.57	.133
Time X diagnosis	72.34	7.8	9.26	.781	.617
Time X menstruation	104.4	7.8	13.37	1.12	.345
Time X diagnosis X menstruation	105.1	7.8	13.46	1.13	.339
Anger					
Between subjects					
Diagnosis	2.56	1	2.56	.067	.798
Menstruation	47	1	47	1.22	.276
Diagnosis X menstruation	5.32	1	5.32	.139	.712

Within subject					
Time	67.51	8	8.4	1.18	.309
Time X diagnosis	23.94	8	2.98	.419	.910
Time X menstruation	74.81	8	9.31	1.31	.238
Time X diagnosis X menstruation	47.74	8	5.94	.836	.572
Fatigue					
Between subjects					
Diagnosis	77.48	1	77.48	9.66	**.014**
Menstruation	44.35	1	44.35	5.52	.047
Diagnosis X menstruation	66.58	1	66.58	8.3	**.020**
Within subject					
Time	83.92	2.66	31.54	1.19	.332
Time X diagnosis	96.53	2.66	36.28	1.37	.278
Time X menstruation	60.72	2.66	22.82	.864	.464
Time X diagnosis X menstruation	47.67	2.66	17.92	.678	.558
Mood swings					
Between subjects					
Diagnosis	103.6	1	103.6	5.36	.026
Menstruation	43.59	1	43.59	2.25	.141
Diagnosis X menstruation	17.4	1	17.4	.901	.349
Within subject					
Time	52.59	7.8	6.69	.869	.541
Time X diagnosis	15.79	7.8	2.01	.261	.977
Time X menstruation	66.12	7.8	8.41	1.09	.368
Time X diagnosis X menstruation	61.66	7.8	7.84	1.02	.421
Breast Sensitivity/tension					
Between subjects					
Diagnosis	102.5	1	102.5	1.93	.172
Menstruation	50.66	1	50.66	.956	.334
Diagnosis X menstruation	111.8	1	111.8	2.11	.154
Within subject					
Time	303.6	9.7	31.12	3.06	**.001**
Time X diagnosis	25.26	9.7	2.59	.255	.989
Time X menstruation	130.7	9.7	13.44	1.31	.221
Time X diagnosis X menstruation	139.5	9.7	14.34	1.4	.177
Headache					
Between subjects					
Diagnosis	113	1	113	1.4	.243
Menstruation	2.43	1	2.43	.030	.863
Diagnosis X menstruation	77.8	1	77.8	.971	.331
Within subject					
Time	179.4	7.9	22.54	1.96	.051
Time X diagnosis	123.9	7.9	15.56	1.36	.214
Time X menstruation	178.7	7.9	22.45	1.93	.052
Time X diagnosis X menstruation	137.9	7.9	17.33	1.51	.152

A three-way mixed ANOVA with time as repeated measured and with Greenhouse-Geisser correction was run to understand the effects of time, menstruation and disordered eating on dependent variables (Craving, Bloating, Physical Pain, Anxiety, Sadness, Anger, Fatigue, Mood Swings, Breast Sensitivity/tension and Headache).

The variable "Craving" showed a significant effect of time, resulting in a significant difference in the estimated mean of the level of craving at different time points, $F(5, 227) = 135.68$, $p = < .001$. Moreover, the interaction between menstrual status and time showed that there was a significant difference in the estimated mean

of the level of craving at different time points, F (5, 227) = 41.25, p = < .001. This means that the level of cravings varied across time points, especially if menstruation was present, as Figures 17 and 18 show.

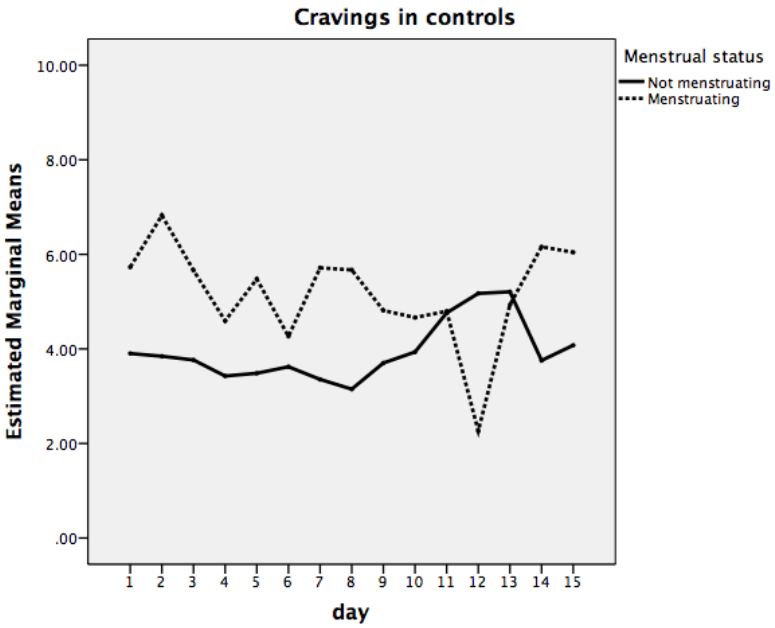

Figure 17. Longitudinal changes in the level of cravings in Controls by menstrual status

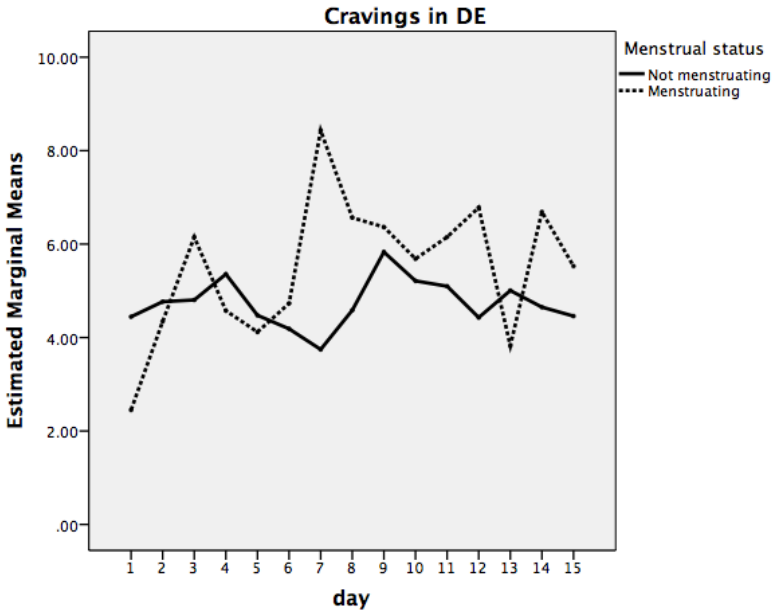

Figure 18. Longitudinal changes in the level of cravings in DE by menstrual status

As the figures show, in the DE group the cravings were more frequent on menstrual days compared to non-menstrual days. A similar trend occurred in controls, but the levels of cravings during menstrual days were lower than in the DE sufferers.

The variable "Bloating" showed a significant effect of time, resulting in a significant difference in the estimated mean of the level of bloating at different time points, $F(8.8, 360) = 3.39$, $p = < .001$. The effect of menstruation and the interaction between factors were not significant. This means that the feeling of bloating varied during the two-week period independently from menstrual status and diagnostic group, as Figures 19 and 20 show.

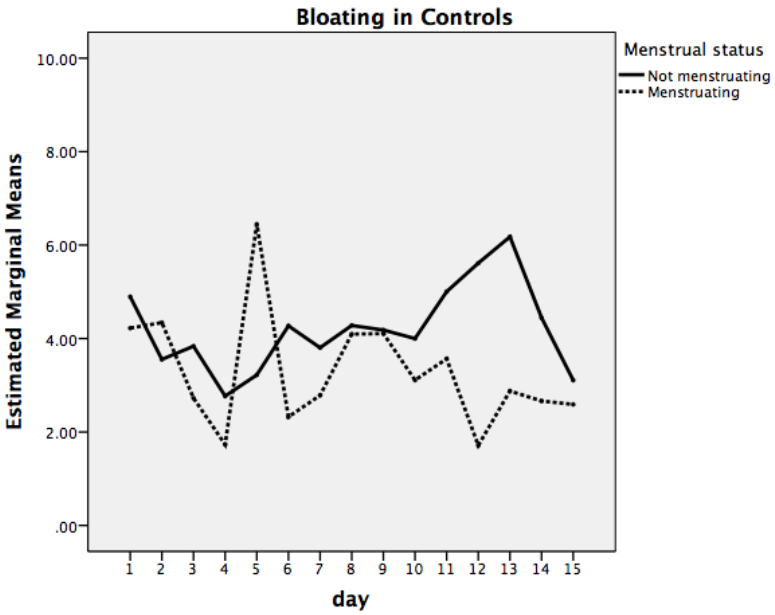

Figure 19. Longitudinal changes in the level of bloating in Controls by menstrual status

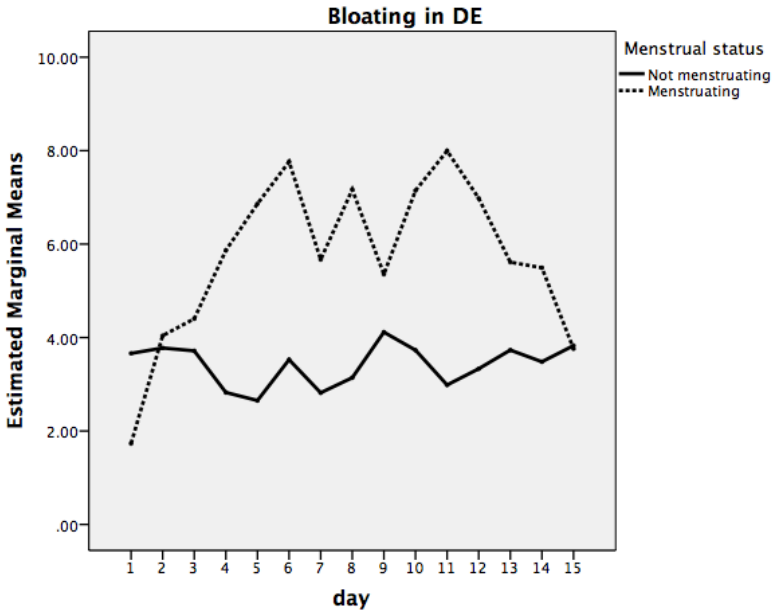

Figure 20. Longitudinal changes in the level of bloating in DE by menstrual status

As the figures show, the level of bloating was higher during menstrual days compared to non-menstrual days in the DE group. On the other hand, controls did not show much difference in the level of bloating between menstruating and non-menstruating days.

The variable "Physical pain" showed a between-group effect of diagnostic group, resulting in a non-significant difference in the estimated mean of the level of physical pain in DE participants and controls, $F(1, 41) = 5.38$, $p = .037$, as Figures 21 and 22 show.

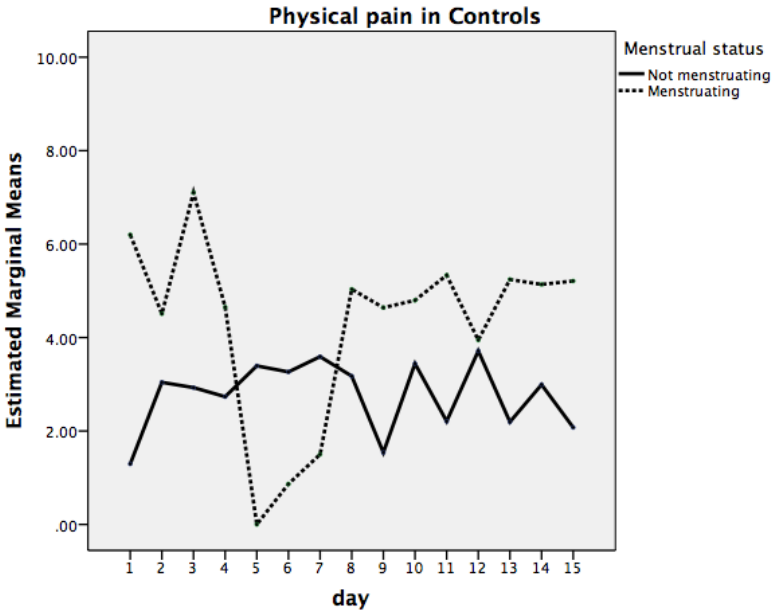

Figure 21. Longitudinal changes in the level of physical pain in Controls by menstrual status

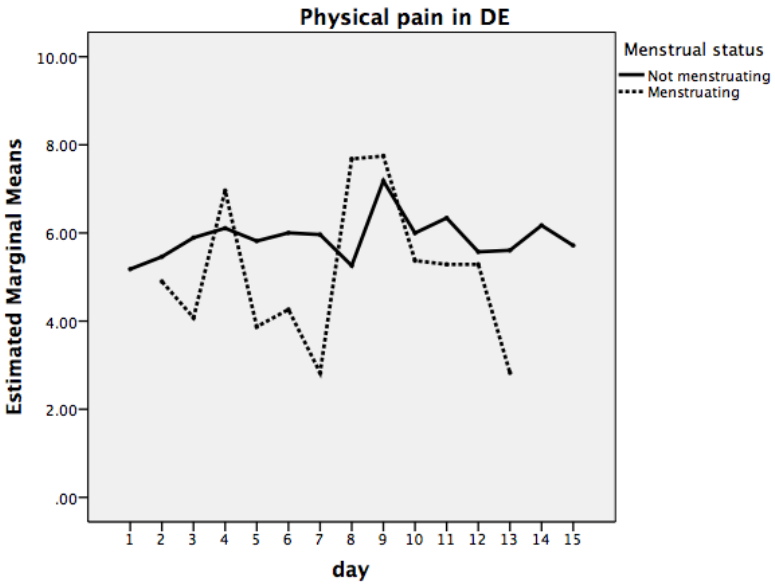

Figure 22. Longitudinal changes in the level of physical pain in DE by menstrual status

As the Figures show, the level of physical pain did not vary much between menstrual and non-menstrual days in DE participants. On the other hand, controls showed a higher level of physical pain during menstrual days compared to non-menstrual days, even though the level was very low between Day 3 and 7. This means

that the experience of physical pain was not strongly related to menstrual status both in DE participants and controls.

The variable "Anxiety" showed a significant difference of time in the estimated mean of anxiety at different time points, F (9.09, 445) = 2.47, p = < .001. This means that the level of anxiety varied across time points, despite the presence of menstruation and the diagnostic group, as Figures 23 and 24 show.

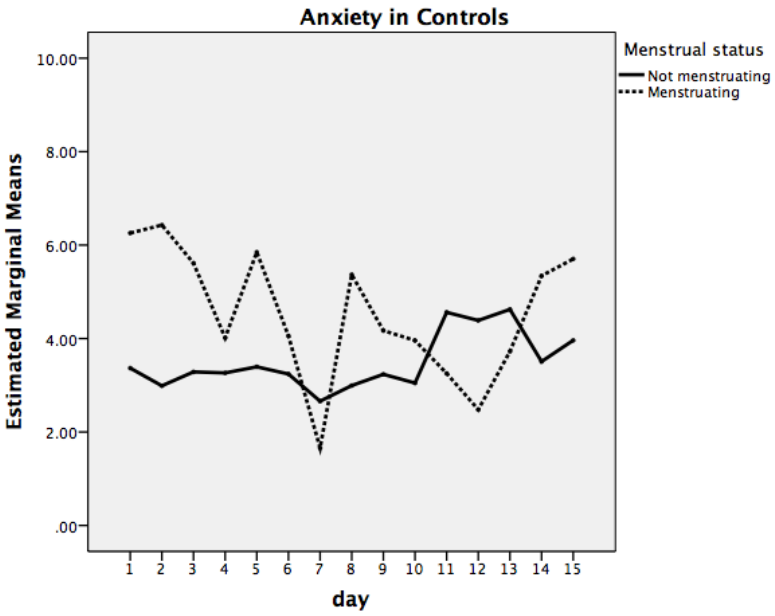

Figure 23. Longitudinal changes in the level of anxiety in Controls by menstrual status

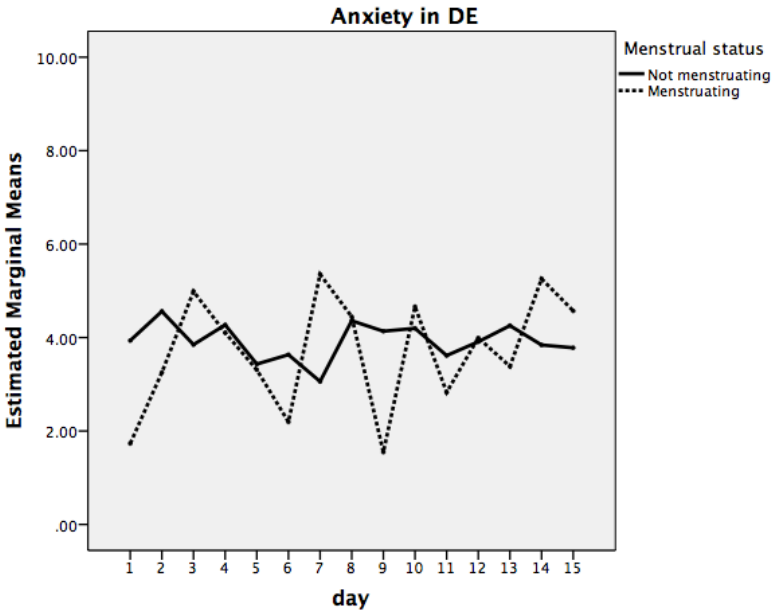

Figure 24. Longitudinal changes in the level of anxiety in DE by menstrual status

As the figures show, there was not a significant difference between the level of anxiety during menstruating and non-menstruating days in both DE and controls, even though controls showed a slightly higher level of anxiety during menstrual days compared to DE.

The variable "Sadness" showed a non-significant between-group effect of menstrual status on the level of sadness, despite the time and diagnostic group, $F(1, 34) = 4.79$, $p = .034$, as Figures 25 and 26 show.

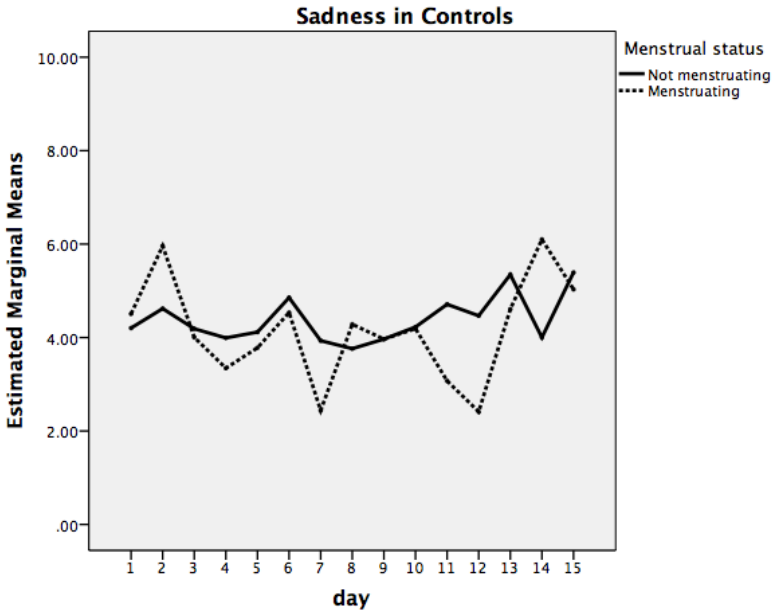

Figure 25. Longitudinal changes in the level of sadness in Controls by menstrual status

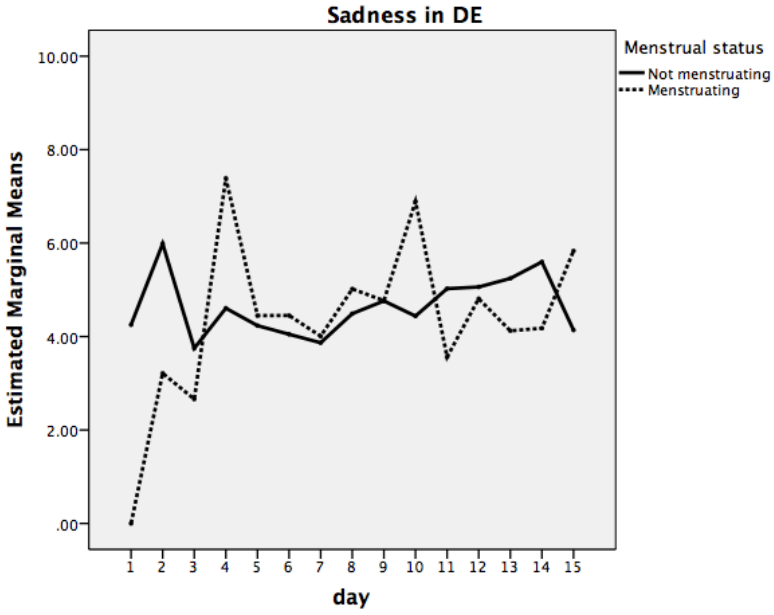

Figure 26. Longitudinal changes in the level of sadness in DE by menstrual status

As the figures show, there was not a significant difference between menstruating and non-menstruating days in DE and controls.

No significant results have been found for the variable "Anger", meaning that the variability of the level of anger was not dependent on time, menstrual status and diagnostic group.

The variable "Fatigue" showed a non-significant between-group effect of menstrual status [F (1, 8) = 5.52, p = .047], but a significant between-group effect of diagnostic group [F (1, 8) = 9.66, p = .014] on the level of fatigue, despite the time. Moreover, there was a significant two-way interaction between diagnostic group and menstrual status in determining the level of fatigue [F (1, 8) = 8.3, p = .020], meaning that diagnostic group and menstrual status were responsible for the variability in the level of fatigue, as Figures 27 and 28 show.

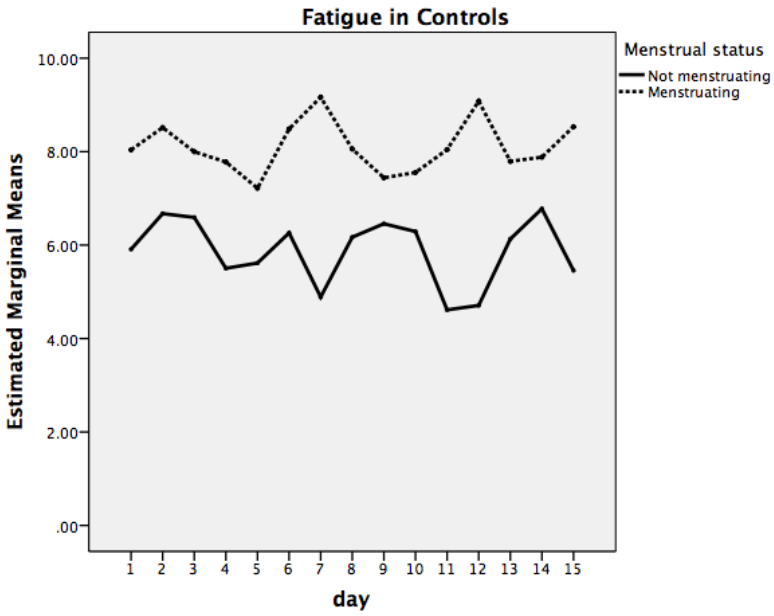

Figure 27. Longitudinal changes in the level of fatigue in Controls by menstrual status

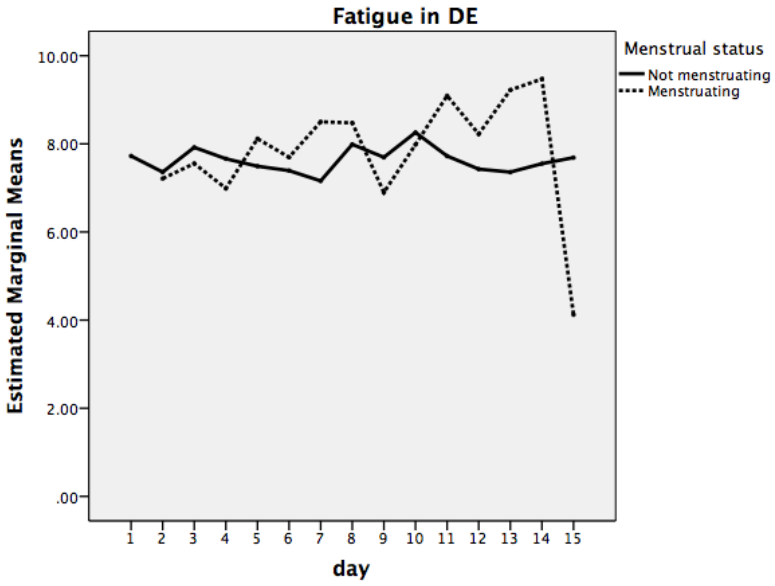

Figure 28. Longitudinal changes in the level of fatigue in DE by menstrual status

As the figures show, there was a higher level of fatigue during menstruating days compared to non-menstruating days in controls. On the other hand, in the DE group, there was not a significant difference between non-menstruating and menstruating days.

The variable "Mood swings" showed a non-significant between-group effect of the diagnostic group [F (1, 37) = 5.36, p = .026] on the level of mood swings. On the other hand, no within-group effect was significant, meaning that time and two- and three-way interactions with time are responsible for the level of mood swings, as Figures 29 and 30 show.

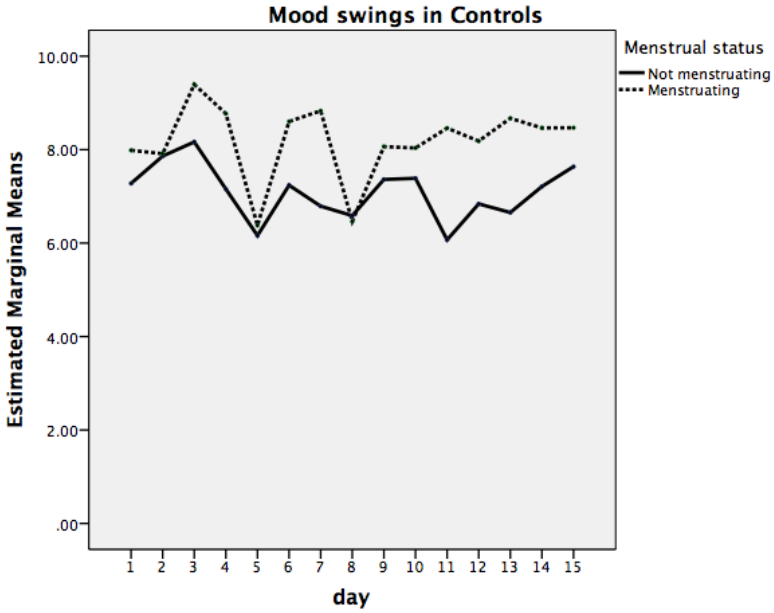

Figure 29. Longitudinal changes in the level of mood swings in Controls by menstrual status

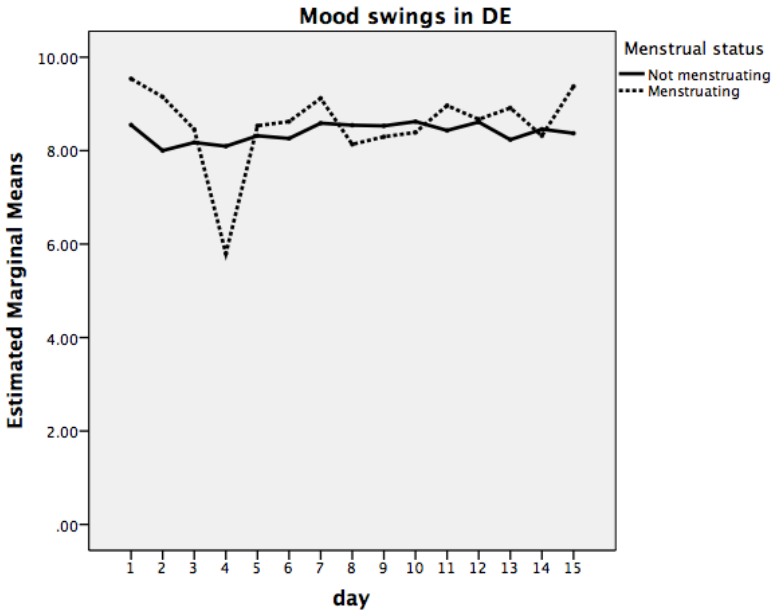

Figure 30. Longitudinal changes in the level of mood swings in DE by menstrual status

As the figures show, the level of mood swings experienced during menstruation was higher in controls than in DE subjects. In the DE group, the difference between menstruating and non-menstruating days was minimal; in some

days (from Day 2 to Day 4), the levels of mood swings were even lower during menstruation than during non-menstruating days.

The variable "Breast Sensitivity/tension" showed a significant within-group effect of time [F (9.7, 369) = 3.06, p = .001], resulting in a significant difference in estimated mean of the level of breast sensitivity at different time points as Figures 31 and 32 show.

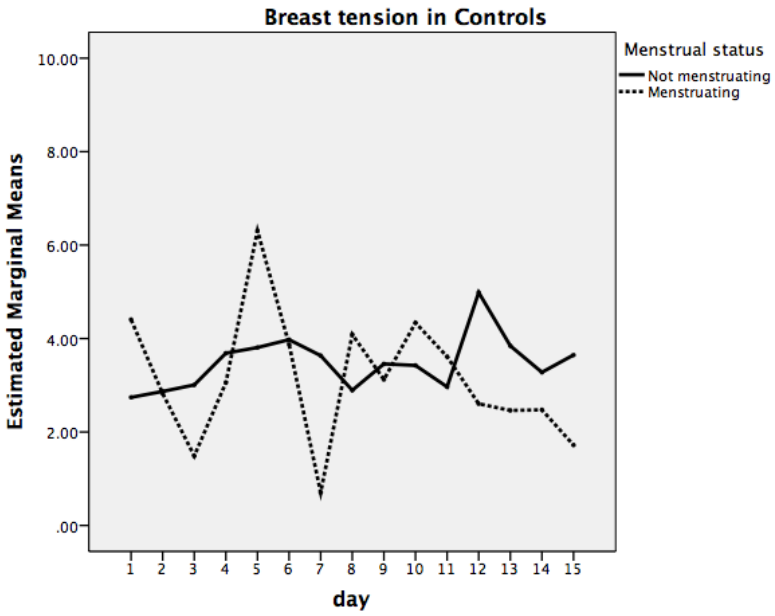

Figure 31. Longitudinal changes in the level of breast tension in Controls by menstrual status

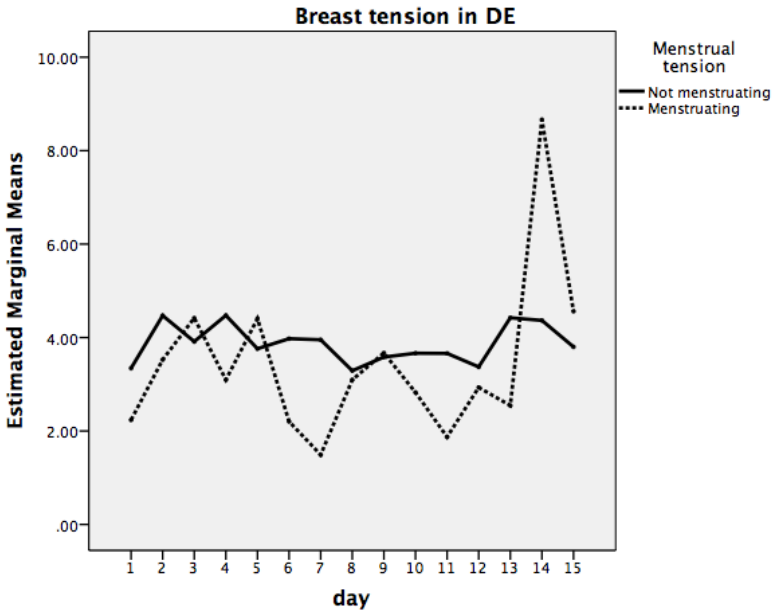

Figure 32. Longitudinal changes in the level of breast tension in DE by menstrual status

As the figures show, there was not a significant difference between menstruating and non-menstruating days in the level of breast sensitivity/tension in DE participants and controls, even though, both controls and DE subjects seemed to experienced more variability in sensitivity and tension of breasts during menstruation compared to non-menstruating days (Control ranged from an estimate marginal mean of 6.2 to 0.5; DE ranged from an estimated marginal mean of 1.5 to 8.5).

The variable "Headache" did not show any significant within- between-group effect, meaning that the level of headache was not related to menstrual status and diagnostic group.

Discussion

The present dissertation sought to further understand the psychological, situational and physical factors that contribute to disordered eating (DE), which is a subclinical eating disorder characterised by a wide range of abnormal eating behaviours, many of which are shared with diagnosed eating disorders. The main difference between disordered eating and eating disorders is the level of severity and frequency of behaviours.. Even though less severe, disordered eating is associated with significant distress and psychological impairment and it might develop into a full eating disorder with time (Pacanowski, Bertz, & Levitsky, 2014).

In accordance with the biopsychosocial model (Smolak & Levine, 2015), the multifactorial nature of eating pathology has been investigated considering each factor per time, while little is still known about how they might interact. Moreover, previous research has mostly studied clinical eating disorders (such as anorexia nervosa, bulimia nervosa and binge eating), while subclinical eating disorders, such as disordered eating, has not been investigated enough.

Even though little is known about disordered eating compared to eating disorders, previous research on eating pathology has provided important clues regarding influential factors over eating disorders, which can be tested on disordered eating. For example, the relationship between insecure attachment, negative affect and eating pathology has been well documented in the literature (Tasca et al. 2014; Tasca et al. 2013; Tasca et al. 2001; Tasca et al. 2009) and a similar relationship might be present in disordered eating as well (Ty & Francis, 2013). Even though studies show that these factors are important in eating pathology, their role and how they interact is still uncertain.

For example, literature seems to support the association between the increase in food intake in response to negative emotions (Fassino, Leombruni, Piero, Abbate-Daga, & Rovera, 2003), but it fails to pinpoint with precision the specific role of negative affect in relation to the specific eating episode. For instance, they showed both an increase in negative affect prior to (Berg & Crosby, 2015; Berg et al., 2013) and/or after eating (Engel et al., 2013), while others showed a decrease in negative affect after eating (Berg & Crosby, 2015; Berg et at., 2013; De Young et al., 2013).

Moreover, negative affect is a broad umbrella term encompassing multiple facets and many types of emotional experiences and current literature failed to determine with precision which particular facet of negative affect has a larger contribution to eating pathology (Berg & Crosby, 2015; Heron, Scott, Sliwinski, Smyth, 2014; Berg et at., 2013; De Young et al., 2013).

Literature has also found that the immediate context or setting might have an influence on eating behaviours (De Castro, King, Duarte-Gardea, Gonzalez-Ayala, & Kooshian, 2012). For example, stressful situations seemed to predict increases in negative affect associated with eating pathology when tested simultaneously against one another (Goldschmidt & Wonderlich, 2014; Lavender et al., 2013). Unfortunately these results apply just to women with bulimia nervosa, while other eating disorders or subclinical eating disorders, as well as general population, have not been fully investigated (Smyth & Wonderlich, 2009; Smyth & Wonderlich, 2007).

Moreover, literature shows that eating behaviours might also be affected by time, location, cohabitation status and absence of others. For instance, people tend to eat more in the evening (Allison, Goel & Ahima, 2014), during the weekend (Haines, 2003) or if they are living alone (Tani, 2015). In particular, the absence of others seems to be associated with unhealthy dietary behaviours (Tani et al, 2015).

Literature indicates, also, that hormonal changes across the menstrual cycle might influence eating intake and eating pathology, but the results are inconsistent. For example, lower oestradiol and higher progesterone levels were associated with increases in binge eating and emotional eating (Hildebrandt, Alfano, Tricamo & Pfaff, 2010), but other studies indicated that high levels of oestradiol and progesterone are associated with increases of binge eating episodes (Klump & Keel, 2013).

Current literature seems to have some limitations in pinpointing with precision the role of negative affect, menstrual cycle, immediate context and insecure attachment style in eating pathology. In particular, the interaction between these factors has never been fully investigated. The present dissertation has the aim to overcome these limitations using an interaction between ecological and retrospective measures to investigate the role and the interplay between these factors.

The factors under investigation are: hormonal imbalance (PCOS and menstrual irregularities; Larsson et al., 2016), current negative affect (Berg et al., 2013), attachment style (Tasca & Balfour, 2014) and immediate context (Goldschmidt et al., 2015; 2014). It has been hypothesised that an inter-relation of factors might be responsible for disordered eating and they have been tested in concert rather than independently in individuals with disordered eating compared to healthy controls. Main findings are discussed below.

Attachment style in disordered eating

To test the hypothesis that a dysfunctional attachment style would be more likely to precipitate current negative affect in the disordered eating sample (Tasca, 2014), the relationship between attachment style in retrospective measure and negative affect levels in ecological measures has been investigated.

Results show that anxious attachment style lead to increase the prediction of disordered eating along with high levels of negative affect. In particular, the facet loneliness seems to predict the highest levels of disordered eating, when controlling for diagnostic group, gender and BMI.

This might indicate that participants with unhealthy eating attitudes and behaviours were more likely to eat when they experienced loneliness. Moreover, a further investigation shows that an anxious attachment style seems to have a moderating role between the level of loneliness and disordered eating; high levels of loneliness are related to high levels of disordered eating in the presence of an insecure attachment style.

The finding supports the conceptualisation of an insecure attachment as maladaptive patterns of responding to negative affect (Mikulincer et al., 2009), which might lead to an inability to draw upon effective emotion regulation strategies later in life (Ty & Francis, 2013). This might denote that people with an insecure attachment style are less able to employ self-soothing strategies when they experience high levels of the facet loneliness.

Research has suggested that a function of disordered eating may be to regulate emotions by focusing on eating, weight and body shape (Lavender et al., 2015; Tasca et al., 2009). In this scenario, the facet loneliness might be very difficult to properly regulate due to the relational complications of having an insecure attachment style.

In particularly, people with an insecure attachment style might be more sensitive to the feeling of loneliness because an insecure attachment style stems from relationships parents and caregivers, who are unreliable and inconsistent. Children who grow up in these scenarios become adults that are self-critical and insecure. They

tend to seek approval and reassurance from others and they need others to validate their self-worth (Scimmenti & Bifulco, 2015).

Due to the fact that they need constant validation and reassurance from others, the feeling of loneliness might be commonly experienced in eating pathology (Mason et al., 2016). As soon as people do not provide the attention and reassurance people with an anxious attachment style need the result is a strong feeling of abandonment (Southward et al., 2014).

In addition, they might be actually not fully able to recognise this specific facet, but, instead, they will experience a strong anxiety and/or anger for the lack of validation from the other part. The confusion and the incapacity to properly regulate the feeling of abandonment and the consequent anxiety might be related to dysfunctional eating behaviours as a way to cope with the feeling of loneliness (Lavender et al., 2015).

Moreover, an insecure attachment is predictive of a less positive, less stable and more externally dependent self-view (Goodvin, Meyer, Thompson, & Hayes, 2008; Srivastava & Beer, 2005). If a person's sense of self is affected by preoccupation for body shape, weight and food then their sense of interpersonal security may also be jeopardised (Murray et al., 2006). This means that the quality of relationships is related to the quality of the self-evaluation: the feeling of being safe in relationships partially reflects an individual's belief that they are able and worthy of eliciting support and affection from others.

In this case, an insecure attachment style indirectly influences the quality of relationships by increasing preoccupation toward their body perception; a negative view of their self and their body perception increases preoccupation or dismissiveness in the current relationships (Cash et al., 2004). This aspect increases the levels of

negative affect (for example, feelings of loneliness and abandonment), which are addressed with disordered eating behaviour, in order to block, reduce or distract from a the original emotional state (Keating et al., 2013).

To sum up, facets of negative affect seem to play an important role in precipitating current disordered eating behaviours and the present data might provide additional support for the affect regulation model of eating pathology, indicating that disordered eating behaviours might function to mitigate facets of negative affect.

Facets of negative affect

In line with the hypothesis that the quantity and the type of meal eaten, the loss of control, the hunger levels and negative affect would be significantly different between disordered eating participants and controls (Berg et al., 2015, Berg et al., 2013; Goldschmidt et al., 2014, Goldschmidt et al., 2012; Stice et al., 2008, 2001), the purpose of the current research was to investigate the associations among facets of negative affect and disordered eating behaviours in disordered eating participants and controls using data collected via retrospective and ecological measures, which allowed for the variables to be temporally sequenced.

Results showed higher levels of negative affect and more frequent loss of control over eating in disordered eating participants compared to controls. In particular, the disordered eating group reported significantly higher levels of shame, disgust, loneliness, anger and guilt than controls. In addition disordered eating participants were more likely to eat when feelings of disgust and guilt were elevated. This might indicate that situations that triggered feelings of guilt and disgust might be seen as antecedents of eating. The immediate consequence of eating was a general

decrease of negative affect with significant results for the level of dissatisfaction and guilt.

Moreover, results show that over two-hour period, the level of shame, disgust, and guilt increased before eating and decreased one hour after that, meaning that these facets were the most influenced by food. On the other hand, over the seven-day period, the level of shame, disgust, anger and guilt was higher in disordered eating sample compared to controls. Shame, disgust and guilt highly fluctuated over the seven-day, while the level of anger did not vary much.

These data might provide additional information about the mitigating role that disordered eating plays on the level of these facets and they support preliminary evidence that these facets might be particularly important to the pathology of disordered eating and the maintenance of disordered eating behaviours (Goldschmidt et al., 2012).

The most significant facets are addressed below.

Loneliness

Loneliness can be defined as the complex and usually unpleasant emotional response to isolation or lack of companionship (Killeen, 1998). It seems that individuals with disordered eating and eating disorders have a high sensitivity to the absence of connection (Southward et al., 2014).

The results show that when an anxious attachment style was entered in the regression analyses along with loneliness, both significantly contributed in predicting disordered eating. This aspect supports the conceptualisation of anxious attachment as maladaptive patterns of responding to negative affect learned in childhood (Tasca & Balfour, 2014). Since disordered eating symptoms were most strongly associated with

high level of loneliness in the present study, the results suggest that people with an anxious attachment style are more likely to experience feelings of loneliness and to develop unhealthy eating behaviours to cope with it (Levine, 2012).

A possible explanation might be related to the fact that individuals evaluate current relationships based on past relationships (Schimmenti & Bifulco, 2015). This might indicate that the perceptions and expectations of future relationships are influenced by the past relational patterns (Tasca & Balfour, 2014).

For example, an anxious attachment style might be caused by an impoverished social environment during childhood (e.g., as having no close friends in childhood and being bullied; Suzuki & Tomoda, 2015; Troop & Bifulco, 2002). This aspect might be responsible for developing low self-esteem and insecurity, which causes to withdraw and retreat in relationships increasing the feelings of loneliness and isolation (Tasca et al., 2013).

As a matter of fact, literature shows that typical characteristics between those who have an anxious attachment style are an eagerness to please and a tendency to draw self-esteem from approval from others (Suzuki & Tomoda, 2015). It appears that people with an anxious attachment style tend to devalue themselves, have a heightened fear of rejection and they look for external approval (Bamford & Halliwell, 2009).

Research has shown that individuals with these characteristics tend to make upward social comparison more often compared to individuals with a secure attachment style (Corning, Krumm & Smitham, 2006) and they are more susceptible to sociocultural ideas of beauty and thinness (Eggert et al., 2007). The internalisation of thin ideal and social comparison tendencies appear to be major factors in body

dissatisfaction, which seems to have a central, causal function in eating pathology (Van Durme et al., 2015).

Following the socio-cultural ideas of beauty, being thin becomes a way of being successful and being in control, while being fat has been connected with being defeated, passive and unsuccessful. This polarity (winner/loser) is completely relational: on one side the "losing" polarity is characterised by a lack of control over one's eating and one's life, while "winning" polarity is characterised by being successful, thin and beautiful as a result of being able to maintain a strict control over one's eating pattern (Castiglioni et al., 2013).

Since the feeling of "winning" or "losing" is considered a fundamental condition to define the identity and it depends solely on interpersonal comparison, eating disorder and disordered eating sufferers show a strong sensitivity to the judgment of others and to parameters of social success (Ugazio & Fellin, 2009). On the one hand, disordered eating individuals are trying to occupy the winning position, being successful and in control over their life, but on the other hand, they have a fear of being rejected, which brings them back to a passive and defeated position in order to get approval from others.

The control over food intake and weight in disordered eating might be a way to get close to the winning position without being rejected: food becomes a way to be successful and in control, without losing the support and connection with others, as usually food manipulation and weight fluctuation elicit concern and preoccupation (Faccio et al., 2013, 2012).

Since the study confirmed the hypothesis that disordered eating seemed to be influenced by the experience of loneliness, the present findings suggest that

investigating and addressing the feeling of loneliness might be particularly important in reducing disordered eating.

Guilt, shame and disgust

Feelings of shame, guilt and disgust are often elevated among those with an eating pathology. The literature supported that shame and guilt in eating disorders and disordered eating are related to the indigestion of food (Kelly & Carter, 2013; Kuijer & Boyce, 2014), while disgust is experienced toward the individual's own body (Troop, Murphy, Bramon, & Treasure, 2000). For example, guilt and shame in eating pathology is associated with eating-related episodes: people scoring high on restraint scales will experience more shame and guilt when they fail to restrict their food intake than people scoring low on restraint (De Witt, Evers, & De Ridder, 2013).

Interestingly, the present research showed that shame, guilt and disgust had a similar trend. The Ecological Momentary Approach illustrated that disordered eating participants were more prone to eat when experiencing feelings of shame, guilt and disgust and these feelings decreased after the eating episode. A possible explanation might consider that, when disordered eating individuals experience high levels of shame, disgust and guilt, eating might play the role of distraction that help them in short term to reduce those feelings (Freeman & Gil, 2004).

In this case, eating might occur as part of an attempt to escape from negative self-awareness; the attention is focused on the immediate stimulus environment and away from more meaningful levels of cognition, allowing the individual to avoid dealing with ego-threatening information (Fox, Msetfi, Johnson, & Haigh, 2015). Such narrowing of attention, however, also results in disinhibition, creating a situation where individuals are more likely to engage in eating episodes if food is present,

despite the level of hunger (Fox et al., 2015). As the results showed, individuals got pleasure from the consumption of food because of some characteristics that makes its qualities (e.g., taste, smell) particularly appealing (Burgess, Turan, Lokken, Morse, & Boggiano, 2014).

The assumption is that before disordered eating occurs, individuals experience negative affect that they cannot properly regulate prompting them to employ a strategy they have access even though it is highly maladaptive, such as eating (Bennett et al., 2013). This line of reasoning has important implications because it suggests that the problem is not necessarily associated with the experience of negative emotions per se but rather with the lack of adaptive emotional regulation strategies available to properly regulate negative affect (Leehr et al., 2015).

The idea that the emotion itself may not be responsible for disordered eating, but it is the lack of strategies to deal with negative affect that triggers disordered eating behaviours could be related to the fact that disordered eating participants showed higher levels of negative affect (especially shame and guilt) over the seven-day period under observation compared to controls.

Possible explanations might be related to the fact that the inability to regulate feelings of shame and guilt might be unrelated to the food itself. For example, the potential role of shame and guilt might be related to a poor self-esteem, since issues of self-image, self-concept, body-image, self-worth, and self-doubt are extensively grounded in the domain of shame and guilt (Crocker et al., 2014).

In this light, it is notable that deficits in self-esteem are evident in the interrelated tendencies of disordered eating sufferers: construing the self predominantly in terms of body shape, rigidly tying self-worth to external frames of

reference, experiencing the self as ineffective, incompetent, and vulnerable to external control (Herbozo, Schaefer, & Thompson, 2015).

Moreover, it is feasible that the well-documented tendency for people with low self-esteem, such as eating-disordered people, to present an insecure attachment style. Attachment insecurity could have contributed to the development of maladaptive rules and expectations concerning the maintenance of self-worth, explaining high levels of shame and guilt, which might result in the expression of disordered eating symptoms (Mikulincer & Shaver, 2012).

The literature and current results support the fact that an insecure attachment style was significantly, positively associated with emotional dysregulation, which in turn predicted disordered eating (Shakory et al., 2015). Potentially more instructive for the issue of aetiology is the possibility that these facets might be implicated in the difficulty of forming healthy relationship, typically found among people with an insecure attachment style (Van Durme et al., 2015; Pietromonaco et al., 2013).

To sum up, people with disordered eating are more likely to be unaware, uncertain and non-accepting of their negative emotions and, in particular, unable to employ self-soothing strategies when in distress (Ty & Francis, 2013). Hence, disordered eating might be a strategy used to reduce negative affect and increase the sense of well-being.

Anger

Results showed that anger was more elevated in disordered eating individuals compared to controls during the time under investigation, even though it did not vary much over the seven-day period and it did not change in the hour before and after eating. The literature confirmed that anger seems to correlate both with body

dissatisfaction and higher scoring in the EDI (Eating Disorder Interview). In particular, anger suppression and inhibition of negative emotions are associated with an increased risk of eating disorders (Evans & Yates, 2004).

Results from the research showed that disordered eating participants experienced higher levels of anger compared to controls. This might be due to low tolerance to frustration and low impulse control or to repression of behaviours, which might generate anger and irritability. It is important to note that, even though, disordered eating participants showed significant higher levels of anger compared to controls over the period under observation, it did not seem to be related to eating behaviours as it did not change before or after eating. This interesting aspect might be related to the fact that other strategies might be used to deal with high levels of anger.

These data provided preliminary evidence that anger might be particularly important to disordered eating sufferers, as it is the only facet that did not vary much over time (Giovanni et al., 2011; Fassino et al., 2001). Further investigation on which strategies are employed by disordered eating and eating disorder sufferers to deal with this facet might be beneficial to their recovery, as those strategies, if adaptive, might also be extended also to the other facets.

Taken together, the findings support the unique role of negative affect in triggering and maintaining disordered eating, and indicated that disordered eating may function to regulate affect. Although previous research suggested that negative affect has a direct relationship with disordered eating (Berg et al., 2015; Heron et al., 2014), results from this study suggest that negative affect has different relationships with disordered eating depending on the types of feeling and attachment style. While the feeling of loneliness might predict for disordered eating behaviours when moderated

by an anxious attachment style, feelings of shame, guilt and disgust might play an important role as antecedent factors of eating in disordered eating individuals.

Situational factors

The second aim of the present research was the investigation of the proximal situational antecedents that might influence behavioural aspects of eating in disordered eating sample and controls. In this regards, the social context has been identified as a critical determinant of disordered eating episodes (De Castro, King, Duarte-Gardea, Gonzalez-Ayala, & Kooshian, 2012).

Results show that among disordered eating participants eating episodes were more likely to occur when participants were at home by themselves. On the other hand, eating episodes were less likely to occur during physical activities and outdoors. Controls were more prone to eat at restaurants/cafés and with colleagues or other students and they were less likely to eat during a physical activity and outdoors.

The literature supports that energy intake tends to be influenced by factors such as location (e.g., eating at versus away from home), cohabitation status (e.g., living alone versus with others; Tani 2015) and presence of distracting stimuli (e.g., television), hunger and stress; thus, indicating that these cues need to be taken into consideration (Mekhmoukh, Chapelot, & Bellisle, 2012; Nijs, 2010). In particular, studies show that eating behaviours might also be affected by the absence of others. For example, eating alone seems to be associated with unhealthy dietary behaviours and obesity (Tani, 2015).

Results confirmed that being at home and being alone were triggers for eating in the disordered eating sample, while controls showed a different trend. On the one hand, the pattern of results for the controls indicated that eating, even in larger quantities, occurred when they were feeling good, in the evening, at restaurants and

with family and friends. This might indicate that these episodes were possibly a part of a larger social event or celebration. On the other hand, the disordered eating group showed an association with negative mood and eating in certain situation (e.g., at home and being alone).

This aspect might suggest that certain situations might be responsible for increasing specific facets of negative affect, for example feeling of loneliness. Familiar locations (e.g., home) and cohabitation status (e.g., absence of others) seem to have a powerful impact on disordered eating participants.

In accordance with the literature (Goldschmidt et al., 2015; Racine at al., 2013; Laska et al., 2011; Hetherington et al., 2006), two types of eating situation have been identified depending on the type of affect expressed: a negative emotional situation and a positive emotional one.

A negative emotional situation, represented by Figure 33, is characterised by absence of others, presence of food and high levels of negative affect (in particular, loneliness, guilt, shame and disgust). This type of situation is likely to trigger eating episodes in the eating disordered group.

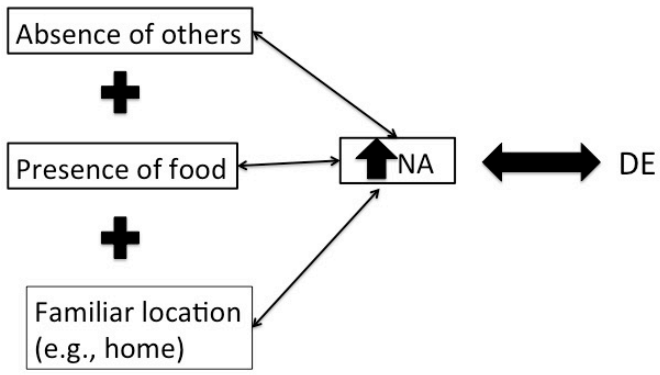

Figure 33. Negative emotional situation

A positive emotional situation of eating, depicted in Figure 34, was characterised by a neutral or positive mood and when a meal was eaten at an out-of-the-ordinary place, for example at a restaurant/café, along with the presence of others and food (Bongers, Jansen, Havermans, Roefs, & Nederkoorn, 2013).

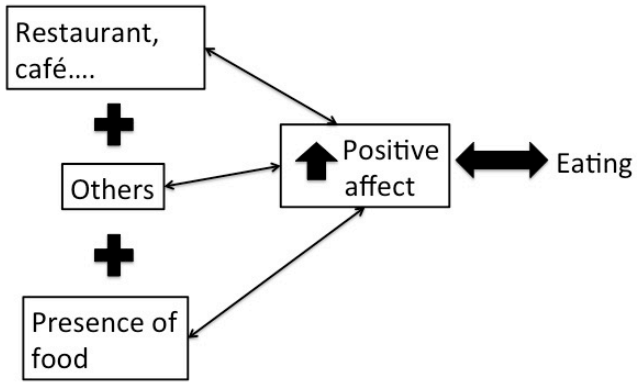

Figure 34. Positive emotional situation

Results show that, although the two groups were susceptible to eat in similar situations, controls found hard resist to food when they were at a restaurant and among colleagues. In fact, it is likely that these individuals planned to eat in such situations, even in larger quantities. Research supports a social facilitation effect in which the amount that people ate was positively correlated with the number of people present (Herman, 2015).

On the other hand, the best predictors of eating in the disordered eating group were a familiar environment (such as being at home) and the absence of others. This aspect might indicate that a particular situation rather than metabolic variables was responsible for influencing the eating pattern, meaning that social environment may play an important role in the onset or maintenance of disordered eating.

Although there is relatively little research examining the relationship between the absence of others and disordered eating, Levine (2012) and Tani (2015) argued that there is an enduring association between absence of others and eating disorder and/or disordered eating symptoms. It is possible that absence of others impacts eating via a reduced capacity for self-regulation (Hawkley & Cacioppo, 2010) and people might use eating as a way of coping with feelings of loneliness.

Literature supports that people who report feeling of loneliness often have higher levels of disordered eating behaviours (Mason, Heron, Braitman, & Lewis, 2016; Waller, Dickson, & Ohanian, 2002). However, all research to date has been cross-sectional in nature, thus limiting our understanding of how the absence of others may influence disordered eating behaviours at the daily level.

The present research utilised an Ecological Momentary design in order to overcome past limitations. The results confirmed the importance of situational factors (e.g., familiar location, absence of others, presence of highly palatable food) in disordered eating as well as individual difference factors (e.g., negative affect). This was the first study to demonstrate there is a within-person situational processes in disordered eating, which is related to the absence of others and familiar location, which might be unique antecedents of disordered eating.

The findings might indicate that disordered eating participants might use food for comfort when feeling lonely and without others to socialise and interact with on a given day. In addition, there might be a more complex relationship between absence of others and disordered eating, for example if we include facets of negative affect.

Disordered eating participants who experience a particular facet (i.e., shame or guilt towards their body) may begin to isolate themselves and as a result they engage in dysfunctional eating pattern to cope. Another possible hypothesis might be that

disordered eating participants, who feel already socially isolated, might experience negative affect (i.e., loneliness) and they might engage in disordered eating as result of that (Ray, 2012).

Figures 35 and 36 represent the cycles of negative affect and disordered eating. In the first cycle (Figure 35) disordered eating is the result of experiencing a particular distressing feeling (in this case body shame), which causes disordered eating sufferers to withdraw from relationships (isolation). In the second one (Figure 36) disordered eating is the result of an already impoverished relational environment (isolation).

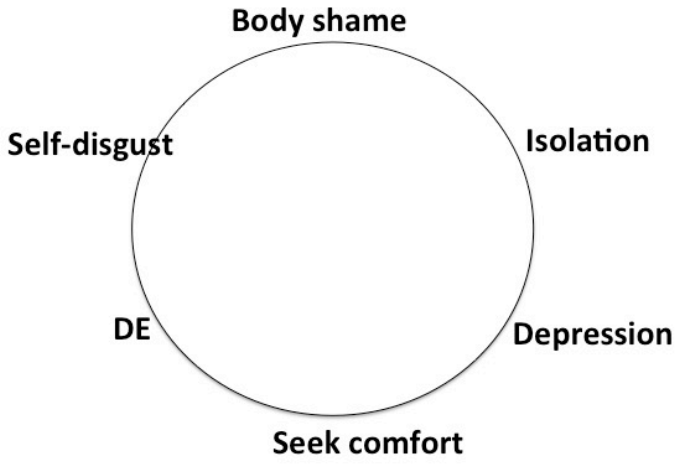

Figure 35. Cycle of body shame and disordered eating

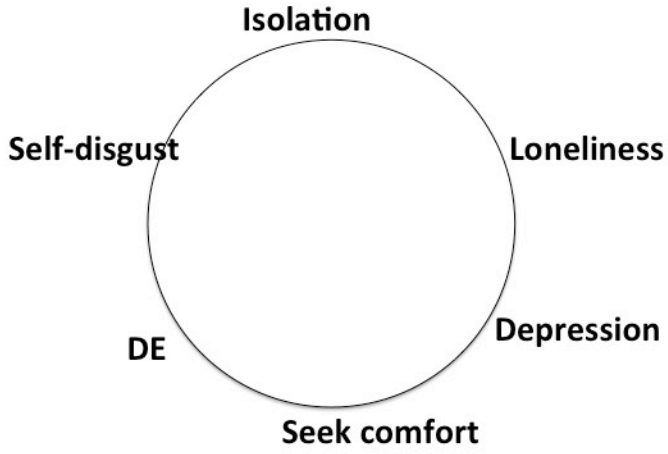

Figure 36. Cycle of isolation and disordered eating

This aspect might indicate that the absence of others might not trigger disordered eating by itself, but only in conjunction with specific location (e.g., being at home, being alone) and high level of negative affect (e.g., feeling of loneliness).

In conclusion, this study furthers our understanding of situational antecedents of disordered eating in a sub-clinical sample. Particularly, we found that the absence of others and being in a familiar place (e.g., home) play an important role in precipitating disordered eating behaviours. In the context of the past research, the current findings imply that the role of these factors in eating pathology appears to be complex. Hence, further studies on situations of the absence of others in a familiar place (such as being at home) and their relationship to eating behaviours would be a fruitful undertaking.

Menstrual factors and hormones

Menstrual period and fluctuation of ovarian hormones have been positively associated with aberrant patterns of eating behaviours. For example, the association between fluctuation of ovarian hormone and dysregulated eating seems to be stronger in women with clinically significant levels of binge eating compared to women without binge episodes (Klump et al., 2014), but the results are inconsistent.

Moreover, it has been suggested that the fluctuation of sexual hormones during the menstrual cycle is associated with increases in binge eating and emotional eating (Hildebrandt, Alfano, Tricamo & Pfaff, 2010; Hildebrandt et al., 2015), but different types of hormones showed different pattern across diagnoses, making difficult to generalise the results (Klump & Keel, 2013).

The present research had the aim to further investigate the effect of the menstrual cycle on disordered eating participants and controls over the fifteen-day

under observation. Our findings extended previous work by examining associations between within- and between-person changes in disordered eating across the menstrual cycle in the disordered eating sample and controls.

Overall, disordered eating participants reported greater feelings of bloating in menstruating days compared to non-menstruating days and compared to controls. On the other hand, they reported greater feelings of sadness, physical pain and breast sensitivity/tension during non-menstruating days compared to menstruating days and compared to controls.

Moreover, we found significant changes for cravings, bloating, anxiety and breast sensitivity/tension over the period under observation. In particular, disordered eating participants showed longitudinally higher levels of cravings and bloating compared to healthy controls. On the other hand, there was a similar trend in the level of anxiety and breast sensitivity/tension between disordered eating individuals and controls over the period under observation.

This might indicate that the experience of cravings and bloating during menstruation might play a role in disordered eating since they were more frequent in menstruating days compared to non-menstruating days. On the other hand, controls did not show much difference in the level of bloating between menstruating and non-menstruating days and they experienced less cravings during menstruating days than the disordered eating group.

Overall, our findings add to a growing literature aiming to understand within-person changes in disordered eating across the menstrual cycle. For example, studies show that the strongest predictors of within-subject changes in eating across the menstrual cycle might be changes in ovarian hormones, which might increase feelings

of body dissatisfaction (bloating) and cravings that might drive women to dysfunctional eating behaviours, despite the level of hunger (Ruzicka, 2013).

Women interpret the bodily changes occurring during the menstrual period within the context of life experience and general psychological functioning. Women who are satisfied with their lives are more likely to consider those symptoms positively, whereas those who are unhappy interpret the same symptoms negatively (Chrisler, Marvan, Gorman, & Rossini, 2015).

Due to the high sensitivity toward body shape typical of eating pathology (Bamford & Halliwell, 2009), disordered eating women might have the tendency to pay more attention on bodily changes across the menstrual cycle. If they perceived themselves bloated, they might confuse this aspect with having gained weight. Disordered eating behaviours, for example restricting food, may be used in order to reduce feelings of discomfort and body dissatisfaction (Hildebrandt et al., 2015). Similarly, overeating may be used by menstruating women to reduce cravings and increase feelings of wellbeing (Klump et al., 2014).

On the other hand, even though literature shows a correlation between menstrual irregularities and eating pathology (Klump et al., 2014; Morgan, 1999), result shows that the majority of the disordered eating sample reported regular periods. However, disordered eating participants were significantly more likely to suffer from Polycystic Ovarian Syndrome (PCOS).

Literature supports the association between PCOS and a great number of psychological symptoms, such as body image dissatisfaction and eating disorders, (Farkas, Rigo, & Demetrovics, 2014). Women with PCOS are known to have disturbed appetite regulation (Moran & Norman, 2004) and may therefore have an

increased risk of developing disordered eating, especially bingeing behaviour (Hirschberg, Naessen, Stridsberg, Bystrom, & Holtet, 2004).

Even though, disordered eating behaviours in PCOS is recognised in the literature, previous research has been unable to provide a satisfactory explanation for the relationship between these two conditions. If we take into account the common physical symptoms of PCOS, such as insulin resistance (Diamanti-Kandarakis & Papavassiliou, 2006), hormonal imbalance and high levels of androgens (Escobar-Morreale et al., 2012), a possible connection might be drawn.

For example, due to the presence of insulin resistance and high androgens levels, PCOS women often report cravings, hirsutism, acne and weight gain (Hirschberg, 2009). These aspects might cause a decrease in self-esteem and the development of feelings of body dissatisfaction (Goldschmidt et al., 2010; Grilo, White, Gueorguieva, Wilson, & Masheb, 2013), which prompts disordered eating behaviours, such as dieting, in order to improve physical appearance.

Due to high levels of impulsivity in PCOS women, dieting often results in the development of a binge eating behaviour that further exacerbates feelings of shame and body dissatisfaction. Binge eating increases the attempts to lose weight with intensified dieting, which in turn worsens binge eating behaviours (Albohn-Kuhne & Rief, 2011). These factors seem to cause an exacerbation of PCOS and binge eating behaviour at the same time, making PCOS women more susceptible in engaging and maintaining a binge eating pattern compared to healthy counterparts.

Moreover, PCOS women often experience a more acute hormonal fluctuation over the menstrual cycle, due to the high levels of androgens. These aspects might worsen the experience of cravings and feelings of bloating before or during the

menstrual cycle, contributing to the triggering of disordered eating. Figure 37 summarises the common aspects between disordered eating and PCOS.

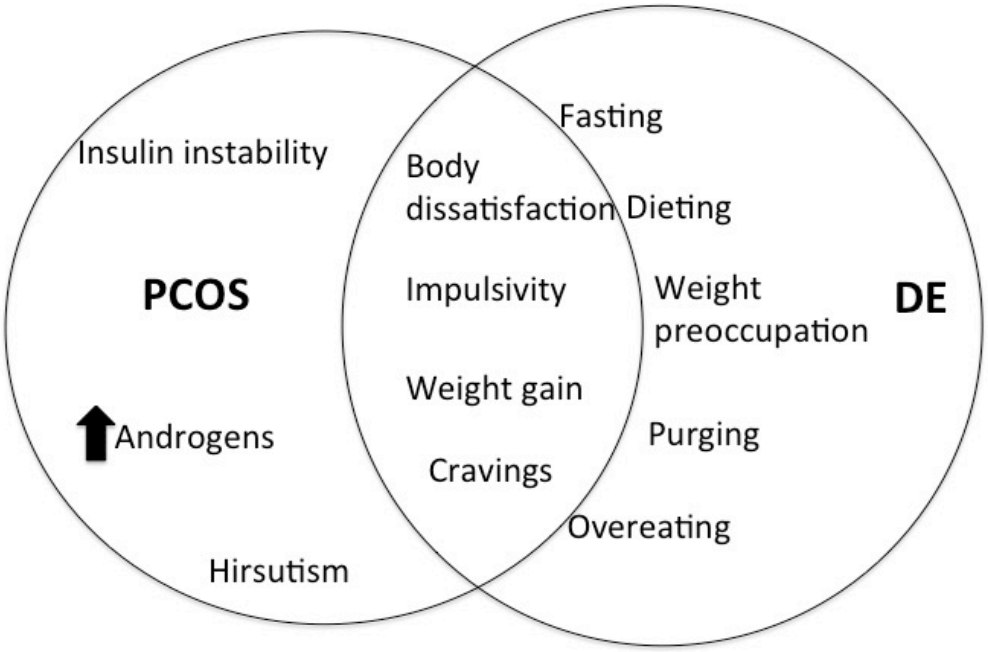

Figure 37. PCOS and disordered eating (DE)

In conclusion, menstruation might be an important factor in disordered eating, which might be intensified by the experience of cravings and bodily changes (e.g., bloating) due to the fluctuation of sexual hormones. Overall, findings from this study suggests that individuals with disordered eating may be more sensitive to physical and psychological changes during menstruation, which might be related to high sensitivity toward body shape and weight fluctuation. If true, this suggests that optimal treatments for disordered eating may be personalised based on individual hormonal function. For example, brief modifications of oestrogen through pharmacological interventions could potentially reduce the likelihood of experiencing negative symptoms during the menstrual cycle in those with disordered eating.

Additional research is needed to replicate these findings, further investigating how hormonal factors directly and indirectly affect the maintenance of disordered eating. Such research has the potential to clarify the viability of ovarian hormones as potential treatment targets for disordered eating during certain phases of the illness.

Limitations and future directions

Although this study is one of the first assessing disordered eating in a subclinical population with an ecological approach, which provided valuable information about the importance of negative affect, situational and menstrual factors in maintaining disordered eating, it is not without limitations.

First of all, all the data in the study was self-reported by participants. Despite inherent problems with the use of self-reporting measures, a key concern for any study utilising EMA is its inability to draw causal inferences from longitudinal design. For example, the findings that negative affect increased prior to eating do not indicate that change in this variable caused an individual to eat as this is a correlational design over time.

Second, another limitation is the participant compliance during the study. It is important to note the amount of missing data, as this might have resulted in inaccurate and/or incomplete representation of participants' affect and state throughout the study. However, the amount of missing data was comparable to other studies using EMA protocols (Courvoisier, Eid, & Lischetzke, 2012; Buckner, 2011).

Third, it is important to note that controls reported nine episodes of over-eating with loss of control, which corresponded to the definition of binges. However, it is worth noting that the loss of control is an important feature in the definition of binging and hence it might suggest that occasional loss of control can also happen

among normal eaters. On the other hand, the use of EDE-Q6 (Eating Disorder Examination Questionnaire-6) might have been insufficient to screen out individuals with relatively lower frequencies of disordered eating, since this questionnaire had been created for screening eating disorders. It might therefore be more effective to develop screening measures of disordered eating in a general population in order to reduce possible ambiguities about the eating behaviours.

Fourth, this study assessed the participants' eating pattern, but it was not possible to assess which kind of disordered eating behaviours the disordered eating group were engaging in. Therefore, future studies might benefit from naturalistic approaches in order to detect which type of disordered eating behaviours participants might engage in.

Fifth, the second study has been conducted over a two-week period rather than a 28-day timeframe needed to assess menstrual cycle's phases. This aspect limits the possibility to investigate which menstrual phase mostly influences the eating pattern and whether there are differences between the DE group and controls at different points in the menstrual cycle.

Sixth, in the investigation of attachment style, the only measure of attachment style used was ECR-R. This assessment has the limitation that it measures the attachment in romantic relationships, which is only one potential attachment experience (Fraley et al., 2011).

Seventh, fear items (anxiety scale) from the PANAS-X scale were not included in the study and we decided to focus the study on hostility and guilt items, because anxiety and fear has been already investigated (Levinson et al., 2013; Swinbourne et al., 2012), while EMA literature showed incongruent results on the

trend of facets, such as guilt, shame, anger and disgust (Goldschmidt et al., 2014; Berg et al., 2013; Engel et al., 2013; Engel et al., 2007).

Eighth, the EDEQ-6 was used rather than the EDE interview to investigate the eating disorder behaviours. Even though the EDE interview provides a more detailed and precise assessment of the eating pattern, we opted for a short and self-administered questionnaire due to the type of the study.

This data could have important implications for current psychological treatments that targets affect regulation strategies to cope with intense negative emotions. For example, interpersonal psychotherapy might be very useful in this regard as it focuses on patient's attachment style and communication style, while it works on relieving symptoms and improving interpersonal functioning.

The findings from this research provide a better understanding of the context in which disordered and healthy eaters eat, which might be important in developing more relevant nutrition promotion interventions and nutrition education messaging. In particular, disordered eating sufferers might also benefit from treatments, which aim to improve distress and tolerance in those situations that are considered antecedents and triggering factors of disordered eating (for example, being at home alone).

Due to the fact that the research is lacking data on specific nutrient intake, different dietary assessment methods are needed in future studies to explore the nutrient composition of participants' dietary intakes in a more precise way. Although our data collection methodology was limited in this respect, it allowed us to capture a wide range of contextual characteristics that occur around mealtimes, which are not typically available otherwise.

Moreover, the findings about the importance of the subjective experience of going through menstruation should be taken into account in psychological and

psycho-education treatments. For example, women should be aware that during menstruation, feelings of fatigue and bloating are just due to hormonal fluctuations and do not correspond to weight gain. In addition, the interaction of disordered eating with neurotransmitters may just worsen the effect of hormonal fluctuations, which paradoxically would increase the feelings of fatigue and bloating over time.

Potential psychological and pharmacological treatments that alleviate feelings of bloating and fatigue, as well as increasing positive affect, might be helpful given current results supporting the relevance of the menstrual cycle, affect and context in maintaining disordered eating.

Conclusion

Despite the aforementioned limitations, the study yielded important information regarding affective, situational and menstrual factors in disordered eating in a naturalistic and retrospective environment. This study represented the first application of EMA to disordered eating in a subclinical population assessing the actual negative affects, context and experiences in relation to menstruation, along with providing important retrospective data from screening measures. While previous EMA research studies had focused only on eating disorders, none of them had directly studied disordered eating using a naturalistic approach. The findings also expanded our understanding of which mechanisms might be associated with disordered eating with an approach that distinguished within-day from between-day predictors of disordered eating.

In summary, the results showed that people with disordered eating reported higher levels of negative affect, which might trigger or be triggered by specific situations and physical states in a feedback loop that might reinforce disordered

eating. Thus, dysfunctional eating behaviours might assume the role of helping disordered eating sufferers in emotional regulation and food might be used in order to cope with situations that increase the level of negative affect. For example, disordered eating might be used to cope with feelings of loneliness when a person is at home alone or to increase the sense of well-being during menstruation. Hence, the data provided support for conceptualisations of disordered eating that emphasise the role of emotional functioning in the development and maintenance of disordered eating itself.

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Appendix:

Retrospective Measures

Q101 Thank you for your interest in our research. The study is being conducted by PhD student Chiara Paganini, supervised by Prof Gregory Peterson from the University of Tasmania, School of Medicine and Dr. Isabel Krug from University of Melbourne, School of Psychology.

1. 'What is the purpose of this study?' The purpose of this study is to investigate the effect of possible factors that might affect eating patterns, paying strong attention to feelings and emotions. In addition, we are interested in examining the differences between feelings and emotions during the menstrual cycle. Data will be gathered in relationship to eating episodes, as well as randomly during the day.
2. 'Who can participate in this study?' You are eligible to participate in this study if you are over 18, not pregnant and are interested in contributing to research. You also have to have a smart phone to run the software application used to collect data.
3. 'What does this study involve?' If you agree to participate, you will be asked to record your eating pattern, answering brief surveys at your meals and after that as well as randomly during the day for at least 7 days. In order to record your menstrual pattern we ask you to answer a brief questionnaire about your menstrual pattern every day for at least 15 days. In order to take part in the research, you will be supplied with a simple computer/mobile application, which you can download on your personal device. Before downloading the app, we ask you to complete the following questionnaires to help us gather some background information on your current and previous eating behaviours. It is important to understand that your involvement is this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences to you if you decide not to participate. If you decide to discontinue participation at any time, you may do so without providing an explanation.
4. 'Are there any possible benefits from participation in this study?' The monitoring methodology used in this study will help you gain some useful insight into your eating, habits and experiences because we will provide you with reports about your eating and menstrual pattern. In addition you will have the possibility to participate at the contest for an IPad as a prize for your support in the research.
5. 'Are there any possible risks from participation in this study?' This study involves the disclosure of eating patterns that you may find sensitive or embarrassing. However, the information that you provide to us is confidential. You are free to discuss your participation with your general practitioner and withdrawal from the study at any stage and for any reason.
6. 'What if I have questions about this research?' If you would like to discuss any aspect of this study please feel free to contact the PhD candidate researcher, Chiara Paganini (Chiara.paganini@utas.edu.au). She would be happy to discuss any aspect of

the research with you. When the study will be finalised, the main outcomes will be published on the University of Tasmania and University of Melbourne websites where you can find reports and additional information.
7. 'How will my confidentiality be protected?' All information will be treated in a confidential manner and your name will not be used in any publication arising out of the research. Electronic data will be securely stored for 7 years. The researchers will maintain confidentiality and the information will be used for the research.

This study has been approved by the Tasmanian Health Research Ethics HREC Comittee (HREC: H0013489).

If you have concerns or complaints about the conduct of this study should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email: human.ethics@utas.edu.au.

Thank you for taking the time to consider this study.

Ms Chiara Paganini – Chiara.paganini@utas.edu.au
Student researcher and PhD candidate
Prof Gregory Peterson – Gregory.peterson@utas.edu.au
Principal researcher and supervisor
Dr Isabel Krug – isabel.krug@unimelb.edu.au
Principal researcher and co-supervisor

Consent form for persons participating in research project:
Names of Researchers:
Prof Gregory Peterson (gregory.peterson@utas.edu.au)
Dr Isabel Krug (isabel.krug@unimelb.edu.au)
Ms Chiara Paganini (chiara.paganini@utas.edu.au)
School of Medicine University of Tasmania
Melbourne School of Psychological Sciences
The University of Melbourne

By clicking the "Accept" button below, you agree to the following:
1. I have read and understood the 'Information Sheet' for this project.
2. I have read and understood the nature and possible effects of the study.
3. I understand that the study involves seven [7] and fifteen [15] days of monitoring. While in the study, I will be asked to record my eating/drinking behaviour and my cognitive and emotional processes using a simple application downloadable on my personal computer/phone.
4. I understand that all research data will be securely stored on the University of Tasmania and University of Melbourne premises for at least seven years, and will then be destroyed when no longer required. I am aware that the study is run from

university HTTP servers of the kind typically used to handle credit card transactions; hence, the responses cannot be viewed by unauthorized third parties (e.g., computer hackers).
5. I agree that research data gathered from me for the study may be published provided that I cannot be identified as a participant.
6. I understand that the researchers will maintain my identity as confidential and that any information I supply to the researchers will be used only for the purposes of the research.
7. I agree to participate in this investigation and understand that I may withdraw at any time without any effect, and if I so wish may request that any data I have supplied to date be withdrawn from the research.

❍ I accept (1)
❍ I decline (2)

Email:

Q1 Gender:

❍ Female (1)
❍ Male (2)

Q2 Age (in years):

Q5 What is your ethnicity?

❍ Caucasian (1)
❍ Aboriginal / Torres Strait Islander (2)
❍ Asian (e.g., Chinese, Korean, Japanese, Vietnamese) (3)
❍ Middle Eastern (4)
❍ Black or African (5)
❍ Others (21)

Q6 What is your highest level of complete education?

❍ Primary (1)
❍ Secondary (2)
❍ Tertiary (Undergraduate or Diploma) (3)
❍ Postgraduate (4)

Q92 Do you have a disability?

❍ No (1)
❍ Yes. Specify: (2) _____

Q0 Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all the questions.

Thank you. Remember that the questions only refer to the past four weeks (28 days) only.
On how many of the past 28 days …..

Q1 Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeed)?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q2 Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q3 Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 15-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q4 Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q5 Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q6 Have you had a definite desire to have a totally flat stomach?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q7 Has thinking about food, eating or calories made you very difficult to concentrate on things you are interested in (for example, working, following a conversation or reading)?

❍ 0 (1)
❍ 1-5 days (2)
❍ 6-12 days (3)
❍ 13-15 days (4)
❍ 16-22 days (5)
❍ 23-27 days (6)
❍ Every day (7)

Q8 Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?

- ❍ 0 (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q9 Have you had a definite fear of losing control over eating?

- ❍ 0 (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q10 Have you had a definite fear that you might gain weight?

- ❍ 0 (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q11 Have you felt fat?

- ❍ 0 (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q12 Have you had a strong desire to lose weight?

- ❍ 0 (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q01 Questions 13-18: Please fill in the appropriate number. Remember that the questions only refer to the past four weeks (28 days). Over the past four weeks (28 days) ……

Q13 Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?

Q14 On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?

Q15 Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?

Q16 Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?

Q17 Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight?

Q18 Over the past 28 days, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape or amount of fat, or to burn off calories?

Q02 Questions 19 to 21: Please choose the appropriate number. Please note that for these questions the term "binge eating" means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

Q19 Over the past 28 days, on how many days have you eaten in secret (i.e., furtively)? Do not count episodes of binge eating

- ❍ No days (1)
- ❍ 1-5 days (2)
- ❍ 6-12 days (3)
- ❍ 13-15 days (4)
- ❍ 16-22 days (5)
- ❍ 23-27 days (6)
- ❍ Every day (7)

Q20 On what proportion of the times that you have eaten have you felt guilty (felt that you've done wrong) because of its effect on your shape or weight? Do not count episodes of binge eating

- ❍ None of the times (1)
- ❍ A few of the times (2)
- ❍ Less than half (3)
- ❍ Half of the times (4)
- ❍ More than half (5)
- ❍ Most of the time (6)
- ❍ Every time (7)

Q21 Over the past 28 days, how concerned have you been about other people seeing you eat? Do not count episodes of binge eating

- ❍ Not at all (1)
- ❍ Slightly (2)
- ❍ Moderately (3)
- ❍ Markedly (4)

Q22 Has your weight influenced how you think about (judge) yourself as a person?

- ❍ Not at all (1)
- ❍ Slightly (2)
- ❍ Moderately (3)
- ❍ Markedly (4)

Q23 Has your shape influenced how you think about (judge) yourself as a person?

- ❍ Not at all (1)
- ❍ Slightly (2)
- ❍ Moderately (3)
- ❍ Markedly (4)

Q24 How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?

❍ Not at all (1)
❍ Slightly (2)
❍ Moderately (3)
❍ Markedly (4)

Q25 How dissatisfied have you been with your weight?

❍ Not at all (1)
❍ Slightly (2)
❍ Moderately (3)
❍ Markedly (4)

Q26 How dissatisfied have you been with your shape?

❍ Not at all (1)
❍ Slightly (2)
❍ Moderately (3)
❍ Markedly (4)

Q27 How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?

❍ Not at all (1)
❍ Slightly (2)
❍ Moderately (3)
❍ Markedly (4)

Q28 How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?

❍ Not at all (1)
❍ Slightly (2)
❍ Moderately (3)
❍ Markedly (4)

Q03 Answer to the questions:

Q29 What is your weight at present? (Please give your best estimate.)

Q30 What is your height? (Please give your best estimate.)

Q31 If female: Over the past three-to-four months have you missed any menstrual periods?

Q32 If so, how many?

Q33 Have you been taking the “pill”?

Q0 The statements below concern how you feel in emotionally intimate relationships. We are interested in how you generally experience relationships (think also about your relationships with close friends, parents, grandparents and close relatives), not just what is happening in your current relationship. Respond to each statement by choosing a number to indicate how much you agree or disagree with the statement.

Q1 I'm afraid that I will lose my partner's love.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q2 I often worry that my partner will not want to stay with me.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q3 I often worry that my partner doesn't really love me.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q4 I worry that romantic partners won't care about me as much as I care about them.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q5 I often wish that my partner's feelings for me were as strong as my feelings for him or her.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q6 I worry a lot about my relationships
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q7 When my partner is out of sight, I worry that he or she might become interested in someone else.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q8 When I show my feelings for romantic partners, I'm afraid they will not feel the same about me

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q9 I rarely worry about my partner leaving me.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q10 My romantic partner makes me doubt myself.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q11 I do not often worry about being abandoned

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q12 I find that my partner(s) don't want to get as close as I would like.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q13 Sometimes romantic partners change their feelings about me for no apparent reason.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q14 My desire to be very close sometimes scares people away.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q15 I'm afraid that once a romantic partner gets to know me, he or she won't like who I really am.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q16 It makes me mad that I don't get the affection and support I need from my partner.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q17 I worry that I won't measure up to other people.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q18 My partner only seems to notice me when I'm angry.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q19 I prefer not to show a partner how I feel deep down.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q20 I feel comfortable sharing my private thoughts and feelings with my partner
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q21 I find it difficult to allow myself to depend on romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q22 I am very comfortable being close to romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q23 I don't feel comfortable opening up to romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q24 I prefer not to be too close to romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q25 I get uncomfortable when a romantic partner wants to be very close.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q26 I find it relatively easy to get close to my partner.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q27 It's not difficult for me to get close to my partner.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q28 I usually discuss my problems and concerns with my partner.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q29 It helps to turn to my romantic partner in times of need.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q30 I tell my partner just about everything.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q31 I talk things over with my partner.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q32 I am nervous when partners get too close to me.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q33 I feel comfortable depending on romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q34 I find it easy to depend on romantic partners.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q35 It's easy for me to be affectionate with my partner.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q36 My partner really understands me and my needs.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

Q1 Please, answer all the questions below.

Q2 If female, are your periods regular?
- ❍ Yes (1)
- ❍ No (2)

Q8 If yes, which day of the month does it usually start? (day)

Q105 If not, when did your last period start? (day, month)

Q4 Do you smoke?
- ❍ Yes (1)
- ❍ No (2)

Q5 Do you usually drink alcohol?
- ❍ Yes (1)
- ❍ No (2)

Q6 Past medical history (check any that apply)

- ❑ None (1)
- ❑ Anxiety disorders - panic attacks (2)
- ❑ Diabetes (3)
- ❑ Polycystic Ovarian Syndrome (4)
- ❑ Endometriosis (5)
- ❑ Infertility (6)
- ❑ Depression (7)
- ❑ High Blood pressure (8)
- ❑ Thyroid problem (9)
- ❑ Cancer (10)
- ❑ Eating disorders (11)
- ❑ Osteoporosis (12)
- ❑ Irritable bowel (13)
- ❑ High cholesterol (14)
- ❑ Kidney problem (15)
- ❑ Other (17)

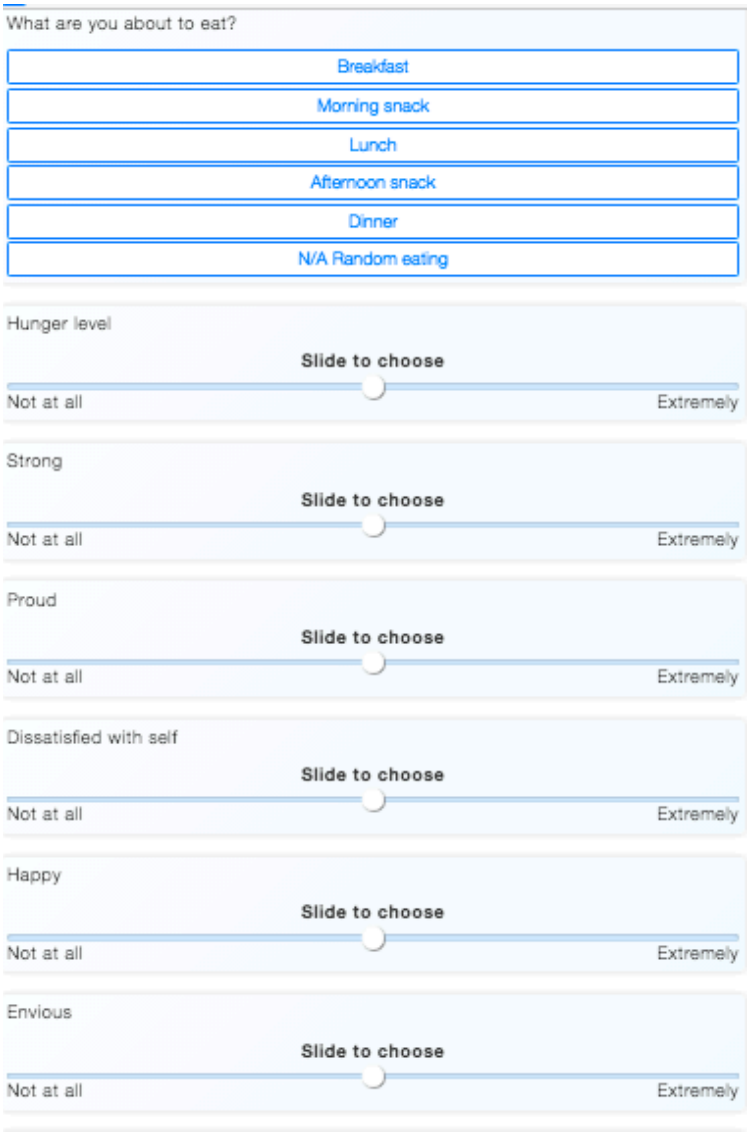
Q7 Family history (check any that apply)

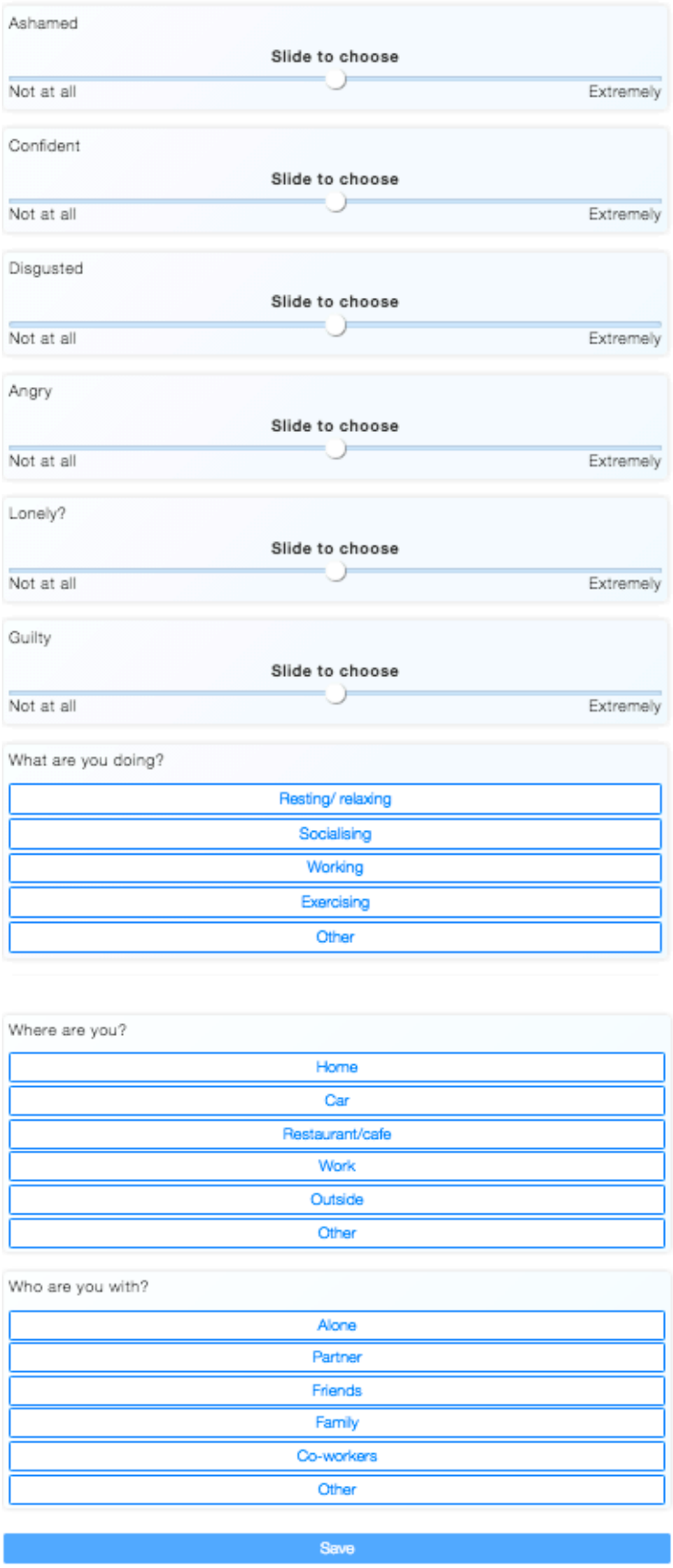
- ❑ Diabetes (1)
- ❑ Cardiovascular disease (2)
- ❑ Breast Cancer (3)
- ❑ Ovarian Cancer (4)
- ❑ Endometriosis (5)
- ❑ Polycystic Ovarian Syndrome (6)
- ❑ Depression/anxiety (7)
- ❑ Eating Disorders (8)

Q104 Thank you very much for completing the survey, you will now receive a confirmation email with all the details for acceding the app.

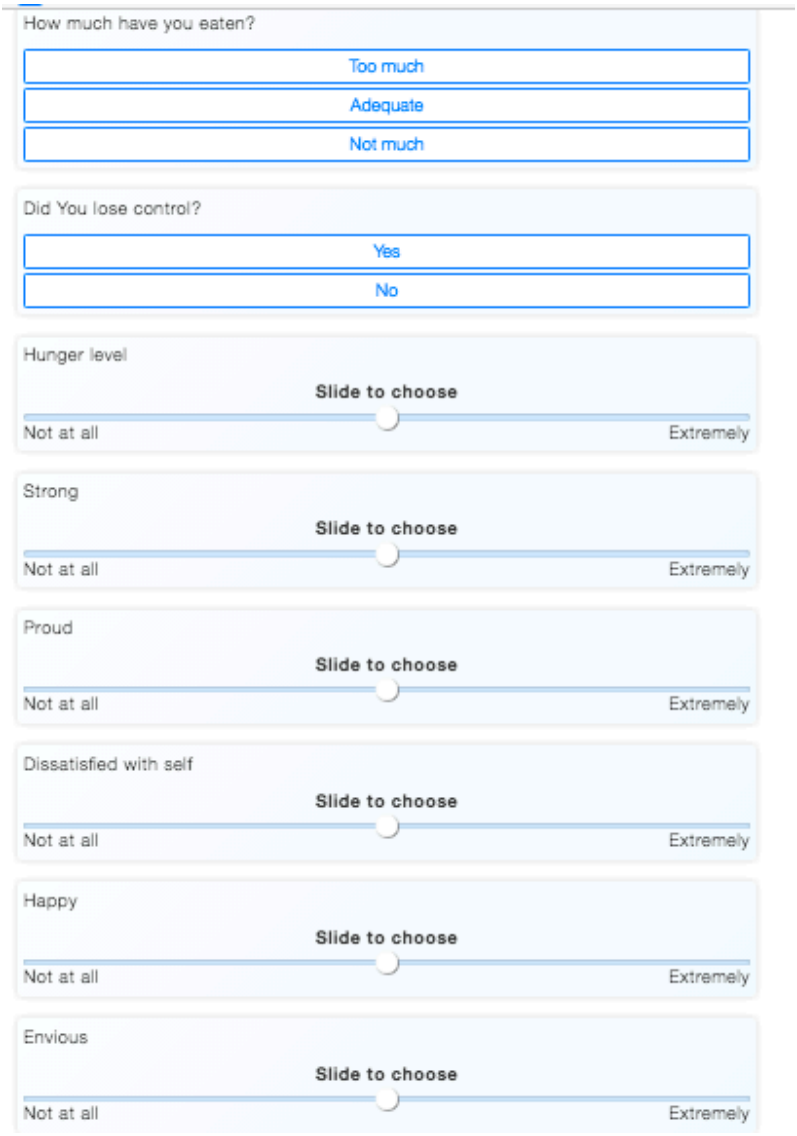
Ecological Measures

Contingent event –Pre meal




Ashamed
Slide to choose
Not at all
Extremely
Confident
Slide to choose
Not at all
Extremely
Disgusted
Slide to choose
Not at all
Extremely
Angry
Slide to choose
Not at all
Extremely
Lonely?
Slide to choose
Not at all
Extremely
Guilty
Slide to choose
Not at all
Extremely
What are you doing?
Resting/ relaxing
Socialising
Working
Exercising
Other
Where are you?
Home
Car
Restaurant/cafe
Work
Outside
Other
Who are you with?
Alone
Partner
Friends
Family
Co-workers
Other
Save

Contingent event – Post Meal




Ashamed
Slide to choose
Not at all
Extremely
Confident
Slide to choose
Not at all
Extremely
Disgusted
Slide to choose
Not at all
Extremely
Angry
Slide to choose
Not at all
Extremely
Lonely?
Slide to choose
Not at all
Extremely
Guilty
Slide to choose
Not at all
Extremely
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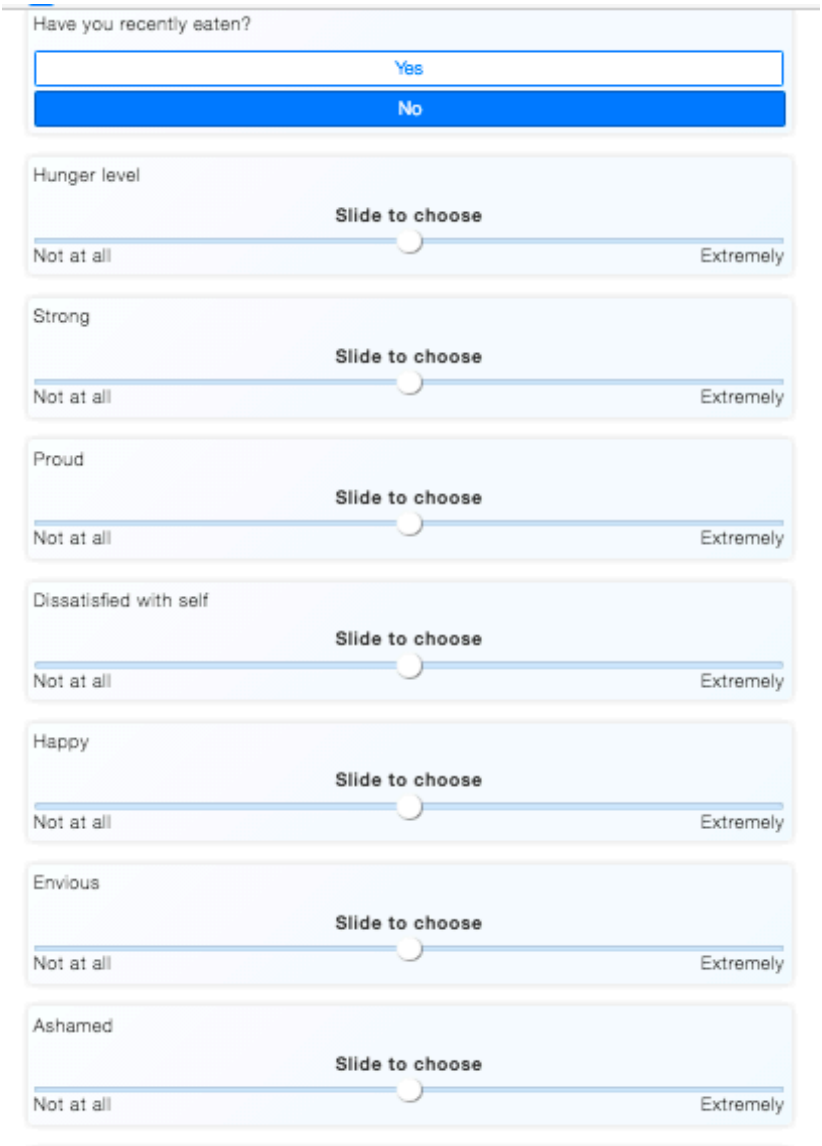
Socialising
Working
Exercising
Other
Where are you?
Home
Car
Restaurant/cafe
Work
Outside
Other
Who are you with?
Alone
Partner
Friends
Family
Co-workers
Other
Save

Random prompt




Confident
Slide to choose
Not at all
Extremely
Disgusted
Slide to choose
Not at all
Extremely
Angry
Slide to choose
Not at all
Extremely
Lonely?
Slide to choose
Not at all
Extremely
Guilty
Slide to choose
Not at all
Extremely
What are you doing?
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Who are you with?
Alone
Partner
Friends
Family
Co-workers
Other
Save

Menstruation final report